**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION**

OCEAN SEMICONDUCTOR LLC, *Plaintiff,* vs. MEDIATEK INC., ET AL., *Defendant.*	Case No. 6:20-cv-01210-ADA
OCEAN SEMICONDUCTOR LLC, *Plaintiff,* vs. NVIDIA CORPORATION, *Defendant.*	Case No. 6:20-cv-01211-ADA
OCEAN SEMICONDUCTOR LLC, *Plaintiff,* vs. NXP SEMICONDUCTORS NV, ET AL., *Defendant.*	Case No. 6:20-cv-01212-ADA
OCEAN SEMICONDUCTOR LLC, *Plaintiff,* vs. RENESAS ELECTRONICS CORPORATION, ET AL., *Defendant.*	Case No. 6:20-cv-01213-ADA
OCEAN SEMICONDUCTOR LLC, *Plaintiff,* vs. SILICON LABORATORIES INC., *Defendant.*	Case No. 6:20-cv-01214-ADA
OCEAN SEMICONDUCTOR LLC, *Plaintiff,* vs. STMICROELECTRONICS INC., *Defendant.*	Case No. 6:20-cv-01215-ADA
OCEAN SEMICONDUCTOR LLC, *Plaintiff,* vs. WESTERN DIGITAL TECHNOLOGIES, INC., *Defendant.*	Case No. 6:20-cv-01216-ADA

DECLARATION OF COSTAS SPANOS, PH.D.

I, Costas Spanos, Ph.D., declare as follows:

I. INTRODUCTION

1. I have been retained by counsel for Defendants MediaTek Inc.; MediaTek USA Inc.; NVIDIA Corporation; NXP USA, Inc.; Renesas Electronics Corporation; Renesas Electronics America, Inc.; Silicon Laboratories Inc.; STMicroelectronics, Inc.; and Western Digital Technologies, Inc. as an expert to analyze and explain certain claim terms in U.S. Patent Nos. 6,660,651 ("the '651 patent"), 8,676,538 ("the '538 patent"), and 6,420,097 ("the '097 patent").

2. In rendering my opinions, I considered the items discussed or listed herein, as well as my own experiences in the field of semiconductor manufacturing technology. I have also reviewed the parties' lists of claim terms for construction as well as the parties' proposed constructions.

3. I reserve the right to amend or supplement my opinions in light of further documents, depositions, or discovery disclosures.

4. I am being compensated at my usual hourly rate of $750 and I am being separately reimbursed for any out-of-pocket expenses. My compensation does not depend in any way on the outcome of this case, my particular testimony, or the opinions that I express.

II. QUALIFICATIONS & EXPERIENCE

5. I have attached my Curriculum Vitae as Exhibit 1.

6. I am a Professor of Electrical Engineering and Computer Sciences at the University of California in Berkeley, California.

7. I graduated from the National Technical University of Athens, Greece in 1980 with a five-year diploma in in Electrical Engineering, specialized in Electronics. I then graduated from

Carnegie Mellon University in 1981 with a M.S. in Electrical Engineering, specialized in Computer-Aided Design of Integrated Circuits (ICs), and in 1985 with a Ph.D. in Electrical Engineering, specialized in Computer-Aided Fabrication of ICs.

8. In the course of my professional and academic career, I have taught courses in semiconductor technology and semiconductor manufacturing at both the undergraduate and graduate levels, and I have also presented multiple short courses on the subjects of statistical process control and experimental design in semiconductor manufacturing to industrial audiences.

9. I have published more than 300 peer-reviewed publications on all these subjects and co-authored a well-cited textbook. I have also been involved in co-founding two successful companies. The first, Timbre Technologies, specialized in sub-nm metrology for ultra-fine patterns that need to be produced and controlled during advanced semiconductor processing. The second, OnWafer Technologies, specialized in wireless, in-situ monitoring of critical steps during photolithography and plasma operations. Timbre Technologies was acquired by Tokyo Electron, and OnWafer Technologies was acquired by KLA-Tencor. The technologies Timbre Technologies and OnWafer Technologies were based on are widely in use today across the semiconductor industry.

10. In addition to my academic and commercial work, I have been at times retained as an expert witness in several patent disputes relating to semiconductor manufacturing technology, where I have provided expert opinions and testimony.

III. LEVEL OF ORDINARY SKILL IN THE ART

11. The ’651 patent relates to an adjustable wafer stage on which a process operation is performed on a wafer. ’651 patent at 1:6-11, 2:26-57, 3:9-14, 5:3-29, 7:28-34. The ’538 patent relates to determining a relationship between processing parameters such as temperature or pressure and “faults” (undesired parameter values) detected during processing and adjusting the

weighting of parameters before performing subsequent fault detection algorithms. ’538 patent at 1:9-12, 5:28-59.

12. For each of the ’651 and ’538 patents, a person of ordinary skill in the art at the time of the alleged invention would have had at least a B.S. in mechanical engineering, electrical engineering, materials science engineering, or a related field. A person of ordinary skill in the art at the time of the alleged invention also would have had experience with the technological area relating to the patents at issue. In the case of the ’651 patent, in addition to the educational requirement described above, a person of ordinary skill in the art at the time of the alleged invention would have had four years of experience designing and developing semiconductor fabrication processes and tooling. For the ’538 patent, in addition to the educational requirement described above, a person of ordinary skill in the art at the time of the alleged invention would have had four years of experience working with semiconductor fabrication processes, including computer programming and data analysis. If someone had an M.S. or Ph.D. in mechanical engineering, electrical engineering, materials science engineering, or a related field, then less experience would have been necessary to qualify that person as a person of ordinary skill in the art at the time of the alleged invention for each of the ’651, and ’538 patents.

13. The ’097 patent relates to trimming or reducing the linewidth of a hardmask layer in a semiconductor film stack in order to achieve linewidths of circuit structures (like transistor gates), formed using a hardmask, that are narrower than the linewidths generated by conventional lithography tools at the time of the alleged invention. ’097 patent at 1:4-9, 1:57-63.

14. For the ’097 patent, a person of ordinary skill in the art at the time of the alleged invention would have had a B.S. in chemical engineering, materials science, electrical engineering, physics, chemistry, or a similar field, and three or four years of work experience in integrated

circuit fabrication or related fields. If someone had an M.S. or Ph.D. in chemical engineering, materials science, electrical engineering, physics, chemistry, or a similar field, then less experience would have been necessary to qualify that person as a person of ordinary skill in the art at the time of the alleged invention for purposes of the ’097 patent.

15. I meet the qualifications of a person of ordinary skill in the art for each of the ’651, ’538, and ’097 patents. I have a Ph.D. in Electrical Engineering and several years of experience researching issues and developing solutions in each of the technology areas relating to the patents at issues.

IV. LEGAL STANDARDS

A. Claim Construction

16. I am informed on the law regarding claim construction and patent claims, and understand that a patent may include two types of claims, independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend on an independent claim or another dependent claim. I understand that a dependent claim includes all the limitations that it recites in addition to all the limitations recited in the claim or claims from which it depends.

17. I understand that claim construction is a matter of law for the Court to decide. Claim terms should be given their ordinary and customary meaning within the context of the patent in which the terms are used, *i.e.*, the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention in light of what the patent teaches.

18. I understand that to determine how a person of ordinary skill would understand a claim term, one should look to those sources available that show what a person of skill in the art would have understood disputed claim language to mean. Such sources include the words of the claims themselves, the remainder of the patent’s specification, the prosecution history of the patent

and the cited references (all considered "intrinsic" evidence), and "extrinsic" evidence, such as dictionary definitions and learned treatises and the opinions of qualified experts concerning relevant scientific principles, the meaning of technical terms, and the state of the art.

19. I understand that, in construing a claim term, one looks primarily to the intrinsic patent evidence, including the words of the claims themselves, the remainder of the patent specification, and the prosecution history.

20. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims.

21. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. In making this determination, the claims, the patent specification, and the prosecution history are of paramount importance. Additionally, the specification and prosecution history must be consulted to confirm whether the patentee has acted as its own lexicographer (i.e., provided its own special meaning to any disputed terms), or intentionally disclaimed, disavowed, or surrendered any claim scope.

22. I understand that a person of ordinary skill in the art is deemed to read a claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification. For this reason, the words of the claim must be interpreted in view of the entire specification. The specification is the primary basis for construing the claims and provides a safeguard such that correct constructions closely align with the specification. Ultimately, the interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim as set forth in the patent itself.

B. Indefiniteness

23. I understand that a patent must satisfy a definiteness requirement, which requires that it conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as the invention.

24. I understand that definiteness requires that a patent's claims, viewed in light of the specification and file history from the perspective of a person skilled in the relevant art, inform those skilled in the art about the scope of the invention with reasonable certainty.

25. I understand that patents are presumed valid and indefiniteness is an invalidity defense. So, I understand that indefiniteness must be shown by clear and convincing evidence.

V. "A SIGNIFICANT FAULT" ('538 PATENT CLAIM 5)

Term	Ocean's Construction	Defendant's Construction
"A significant fault" ('538 Patent, Claim 5)	No construction is necessary, or in the alternative, "abnormality or fault that relates to an actual fault."	Indefinite

26. In my opinion, the claim limitation that uses the term "a significant fault" to describe whether a "detected fault" is "a significant fault" in the '538 patent is indefinite. A person of ordinary skill would not be able to understand the scope of those claim limitations with reasonable certainty.

27. Claim 5 of the '538 patent uses the term "a significant fault" to describe a "detected fault." "5. The method of claim 1, further comprising: designated in said computer whether said detected fault is ***a significant fault***; and adjusting said weighting associated with said parameter based responsive to designating said detected fault as ***a significant fault***." A POSITA would not be able to understand the scope of this limitation with reasonable certainty. In this field and in the context of the patent and claims, it is impossible to know how far a fault must deviate from its

expected value to be "significant," or how out of specification a workpiece must be before experiencing a "significant" fault. In other words, it is unclear how far a fault could deviate from its expected value to be an insignificant or normal fault, or how out of specification a workpiece could be and still be experiencing only an insignificant or normal fault. Nothing in the claims or specification of the patent provides any guidance to a POSITA to make this determination and thus understand the boundaries of this term. In my opinion, it would be purely subjective, and depend on, for example, the manufacturing tools, the products being manufactured, the level of precision required by the designer and fabricator, among many other potential factors.

28. I have reviewed the patent and did not find any disclosure that provides a definition, parameters, or other metrics to determine the boundaries of what is or isn't "significant." The specification only explains that "[t]he system 300 analyzes the fault data resulting from the fault data analysis and/or the PCA, in order to determine whether any particular parameters associated with any faults or abnormalities detected that are associated with the processing of semiconductor wafers 105 is actually a significant fault." '538 patent at 11:12-19. There is no disclosure in the patent for how to make that determination, however.

29. The other example of the word "significant" being used in the specification (at 11:29-67) is not related to determining whether a fault is "significant." Instead, it discusses that certain parameters may be a "significant contribution" to a fault. The disclosure does not provide a way to determine what is (or isn't) "significant." See also '538 patent at Fig. 8.

30. A POSITA also would not understand the bounds of the claims because the word "significant," without additional explanation, is a subjective word of degree and it does not indicate any specific amount, range, or parameter to me. It is an inexact term I would never use if I had to describe a value in this field with reasonable certainty. I do not know, for example, if these claims

would cover a situation where a fault is 5% out of specification, or if it would only cover a situation where a fault is 10% out of specification, or a situation where a fault is 15% out of specification. Whether a fault is "significant" may depend on numerous factors not disclosed by the '538 patent. For example, two engineers may disagree whether a "fault" is "significant" due to, e.g., the subjective demands of their customers (e.g., the variance permitted by a customer) or the material used in the manufacturing process (e.g., some materials are more fault tolerant). A POSITA is thus left guessing what qualifies as a "significant" fault in this claim. As such, it is my opinion that a POSITA would not know the outer bounds of what is being claimed with reasonable certainty.

31. I also do not agree with Plaintiff's construction for this term. It does not provide any actual definition and only imports more ambiguity into the term. Rather than provide a construction that defines how much a fault must be out of specification to be a significant fault, Plaintiff instead proposes a construction that redefines the term using unclear concepts such as "abnormality" and undefined terms like "relates to an actual fault." If Plaintiff's alternative construction were to be adopted, it too would fail to inform a POSITA of the bounds of the claim because a POSITA would not understand what is meant by "fault relat[ing] to an actual fault." Moreover, what qualifies as an "actual fault" is itself subjective and dependent on external factors. For example, the exact same fault may be an "actual fault" if the result falls outside the scope of an acceptable variance defined by customer A, but may not be an "actual fault" if customer B has a wider definition of acceptable variance.

VI. "DETERMINING IN SAID COMPUTER WHETHER SAID PARAMETER IS A SIGNIFICANT FACTOR" ('538 PATENT, CLAIM 7)

Term	Ocean's Construction	Defendant's Construction
"determining in said computer whether said parameter is a	No construction is necessary, or in the alternative, "a	Indefinite

significant factor" ('538 Patent, Claim 7)	parameter that provides a significant contribution to the fault."	

32. In my opinion, the claim limitation that uses the term "a significant factor" to describe whether the "parameter" "provides a significant contribution" in the '538 patent is indefinite. A person of ordinary skill would not be able to understand the scope of those claim limitations with reasonable certainty.

33. Claim 7 of the '538 patent uses the term "a significant factor" to describe a "parameter": "7. The method of claim 1, wherein determining in said computer said relationship of a parameter relating to said fault detection analysis to a detected fault further comprises determining in said computer whether said parameter is ***a significant factor*** associated with said fault."

34. A POSITA would consider this term indefinite because, in this field and in view of the patent and its claims, it is impossible to know what would it take to make a "parameter" a "significant contribution associated with [a] fault." Nothing in the claims or specification of the patent provides any guidance. When the term is used in the specification, the specification does not provide a definition or any objective boundaries as to the term's meaning. The specification states: "The system 300 may also comprise a dynamic PCA weighting module 370, which is capable of receiving data automatically and/or manually relating to information indicating whether a particular parameter that was considered abnormal is indeed a significant factor in any detected faults." '538 patent at 7:36–40. There are no metrics, parameters, or even characteristics from the specification that a POSITA could rely on to understand the boundaries of the term.

35. Further, a POSITA would not understand the boundaries of the claims with reasonable certainty because the word "significant" is a subjective word of degree and it does not

indicate a specific amount, parameter, or metric. For example, there is no indication if the claims would cover a parameter where it is 10% responsible for contributing to a fault, or if it would only cover a parameter where it is 25% responsible for contributing to a fault, or if it would only cover a parameter where it is 50% responsible for contributing to a fault. Whether a parameter is a "significant factor" in a fault may depend on numerous factors not disclosed by the '538 patent. For example, two engineers may disagree whether a "factor" is "significant" due to the presence of additional factors that may appear to also be significant. It is an inexact term I would never use if I had to clearly describe a value in this field with reasonable certainty. Thus, it is my opinion that a POSITA cannot know the outer bounds of what is being claimed in this claim with reasonable certainty.

36. I also do not agree with Plaintiff's construction for this term. It does not provide any actual definition and only imports more ambiguity into the term. Rather than attempt to provide a construction that defines how closely linked to a fault a parameter must be in order to be deemed "significant," Plaintiff instead proposes a construction that merely replaces the indefinite "a significant factor" with the equally indefinite "a significant contribution." What qualifies as "a as significant contribution" is itself subjective given the continued use of "significant." The alternative construction still renders it impossible for a POSITA to know the bounds of the claim.

VII. "PNEUMATIC CYLINDER" ('651 PATENT, CLAIMS 19, 75, 81)

Term	Ocean's Construction	Defendant's Construction
"pneumatic cylinder" ('651 Patent, Claims 19, 75, 81)	No construction is necessary, or in the alternative, "a pneumatic, hydraulic, electromagnetic or mechanical device"	Plain and ordinary meaning

37. In my opinion, the claim limitation “pneumatic cylinder” as used in the ’651 patent should be given a construction consistent with its plain and ordinary meaning.

38. The ’651 patent describes different types of mechanisms for “adjusting the position of the wafer stage,” including “pneumatic, hydraulic, electromagnetic, or mechanical systems.” ’651 patent at 5:65–6:1.

39. A POSITA, consistent with the ’651 patent specification, would have understood these to be four different types of devices—all included in Ocean’s construction for pneumatic—that have different ways of causing movement in order to move the wafer stage.

40. A pneumatic device is a device that is powered by compressed air or other gas. “Pneumatic,” means that the power to actuate the device is generated by air or other gas pressure. *See* American Heritage Dictionary published 2001, reissued 2004 (“Of or relating to air or other gases” or “Filled or operated by air”); Dictionary of Engineering 1997 (“Pertaining to or operated by air or other gas”); Merriam-Webster Dictionary 2001 (“of, relating to or using gas (as air or wind)” and “moved or worked by air pressure”); ’651 patent at 6:1–21.

41. One specific type of a pneumatic device is a pneumatic cylinder, which is a cylindrical device that uses pressurized air or other gas to move a shaft (or rod) of the device along a linear path (that is, in a straight line). A pneumatic cylinder is described in the ’651 patent and in the literature known to a POSITA. ’651 patent at 6:1–65, Figure 2 (reproduced below, depicting “pneumatic cylinder 46 … comprised of a housing 47 [and] a shaft 49” where pressurized air or an inert gas is supplied to the cylinder to move its shaft 49 in a linear direction), Figure 3; Pneumatic Systems at 85 (“Pneumatic cylinders offer a straight rectilinear motion to mechanical elements.”), 85 (“The pneumatic power is converted to straight line reciprocation motions by pneumatic cylinders”), 86–89.

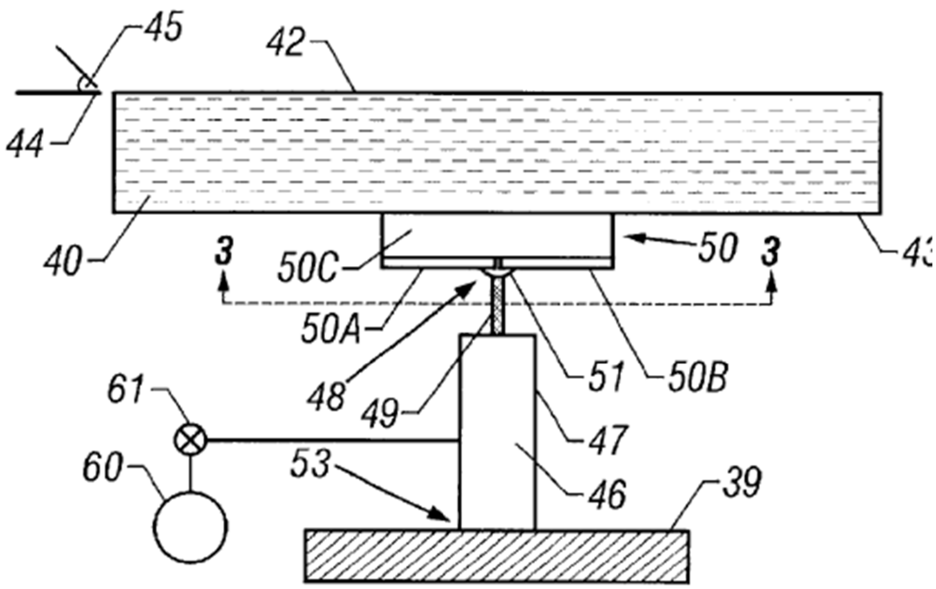


FIG. 2

42. As the ’651 patent notes, in describing the pneumatic cylinders 46 of Figure 2, “The pneumatic cylinders 46 may be any type of pneumatic cylinders useful for performing the function of adjusting the surface 42 of the wafer stage 40. For example, the pneumatic cylinders 46 may be dual-acting pneumatic cylinders. The stroke, size and supply pressure to such cylinders may vary depending upon the particular application. Air or inert gas may be supplied to the cylinders 46 at the required pressure through flexible houses (not shown).” ’651 patent at 6:13–21. The Pneumatic Systems book further describes such a dual (double) acting pneumatic cylinder. Pneumatic Systems at 89.

43. As evidenced by the patent and other literature understood to a POSITA, the critical feature of pneumatic devices is that they are powered by air or other gas pressure.

44. The other types of devices—consistent with their names—are powered by particular means (hydraulic, electromagnetic, and mechanical forces, respectively). More particularly, the second type of device mentioned in the ’651 patent is a hydraulic device, which,

as the "hydraulic" in its name demonstrates, is a device powered by pressurized liquid fluids. The third type, an electromagnetic device, is powered by an electric current and a magnetic field. And the fourth type, a mechanical device, is a device that creates the needed motion through interacting mechanical parts, as, for example, in a rack and pinion configuration.

VIII. "ULTRA-THIN RESIST LAYER" ('097 PATENT, CLAIMS 1-3, 10-17)

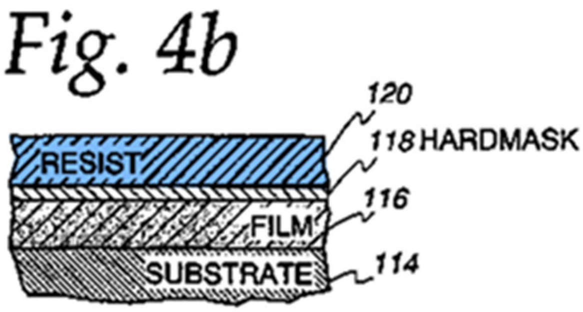
Term	Ocean's Construction	Defendant's Construction
"ultra-thin resist layer" ('097 Patent, Claims 1-3, 10-17)	No construction is necessary.	Indefinite

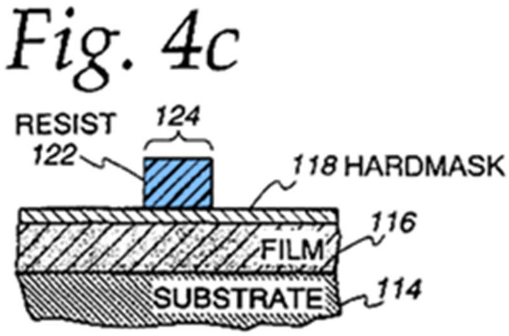
45. I have been asked to opine as to what a person of skill in the art at the time of the invention (POSITA) would have understood by the claim term "ultra-thin resist layer[s]" and whether a POSITA would have understood, based on the claims, specification, prosecution history, and extrinsic evidence, whether "ultra-thin resist layer[s]" has a defined upper limit and if so, what that upper limit is. In this declaration, I use UTR to refer to "ultra-thin resist" and UTR layer to refer to "ultra-thin resist layer[s]."

46. The '097 patent describes a method for forming circuit structures having linewidths smaller than conventional lithography techniques allowed. '097 patent at 1:4–9. Lithography uses light of specific wavelengths to expose and generate linewidth patterns in a layer of photoresist material. '097 patent at 1:16–20. The patterned photoresist is used as a sacrificial layer in the way of creating circuit structures, such as gates, from underlying layers. '097 patent at 1:60–63, 4:14–42.

47. The '097 patent teaches forming the stack of layers shown in Figure 4(b) (see below) that includes substrate 114, device layer 116, hardmask layer 118, and UTR layer 120 (shaded blue). '097 patent at 3:63–4:2. Figure 4(c) below shows that UTR layer 120 is then patterned to form resist mask 122 (shaded blue). Resist mask 122 is further processed to create a

device structure such as a transistor gate with a linewidth narrower than the original width of the resist mask. ’097 patent at 4:14–42.





48. The term “ultra-thin resist layer[s]” (UTR layer) appears explicitly in only claims 1 and 4. ’097 patent at 5:34-35, 5:40-41 (claim 1), 6:7 (claim 4). Without consulting the specification, prosecution history, or extrinsic evidence, a POSITA would have understood that “resist layer” refers to a layer of photoresist and further that “ultra-thin” modifies “resist layer,” so that UTR layer refers to resist layers having thicknesses that would have been considered very thin at the time of the invention. The resist layer’s thickness is the characteristic that qualifies it as “ultra-thin,” which is a term of degree for thickness. That is, UTR layer refers to resist layers having thicknesses that fall within a certain range of thicknesses. However, a POSITA would not have known the limits of that thickness range based on the term alone. In fact, the term UTR layer begs the question as to what range of thicknesses qualifies as a UTR layer in the context of the alleged invention.

49. The claims of the ’097 patent support my opinion that UTR layer corresponds to resist layers having thicknesses that fall within a certain range, given the intended application. Claim 1 does not specify any resist thicknesses. However, claim 4 recites “[a] method of forming circuit structures as claimed in claim 1, wherein the *ultra-thin resist layer has a thickness of less than 2500 Å*” (emphasis added). The language of claim 4 makes clear that for purposes of claim

4 (and claims 5-9, which refer back to claim 4 directly or through an intermediate claim), the UTR layer must have a thickness of less than 2500 Å. That is, a POSITA would understand claim 4 specifies a range of thicknesses for resist layers that qualify as a UTR layer: less than 2500 Å.

50. Because claim 4 depends on claim 1 and includes a limitation on UTR layer not found in claim 1 (the range of "less than 2500 Å"), a POSITA would have understood that the thickness range of UTR layer in claim 1 (and claims 2–3 and 10–17, which refer back to claim 1 directly or through an intermediate claim) has an upper limit **greater** than "less than 2500 Å," that is, an upper limit of 2500 Å or greater. But this again begs the question: what range of thicknesses qualifies as a UTR layer in claims 1-3 and 10-17? A POSITA would have understood that the language of claim 1, considered in light of the language of claim 4, indicates not what the upper limit of UTR layer thickness is, but what it is not—"less than 2500 Å."

51. Likewise, the specification of the '097 patent does not specify an upper limit for UTR layer thickness. The '097 patent states that "a resist coating having an UTR thickness is considered to be resist films of less than 0.25 μm (2500 Å) in thickness" ('097 patent at 1:43–45) and describes the problem associated with the prior art approach when applied to "an ultra-thin resist thickness of less than 2500 Å" ('097 patent at 2:32-34 ("FIGS. 2(a)-2(d) illustrate the problem of applying the conventional lithographic process of FIGS. 1(a)-1(d) to an UTR having a thickness of less than 2500 Å"), 2:58-61 ("Further, the problem associated when the conventional lithographic process is applied to an ultra-thin resist thickness of less than 2500 Å will also be explained in connection with FIGS. 2(a) through 2(d)."), 3:33-40 ("However, when the lithographic process described above in FIGS. 1(a)-1(d) is applied to an UTR thickness of less than 2500 Å, there is created a significant problem in the gate conductor etching process since an excessive amount of resist will have been consumed during the trim process step. As can be seen

in FIG. 2(a), an UTR layer 18a has a thickness of less than 2500 Å as compared to the thicker resist layer 18 of FIG. 1(a).”), Fig. 2a). Similarly, the only thickness associated with UTR layer in the description of the embodiments of the invention is “less than 2500 Å.” ’097 patent at 4:12-13 (“UTR layer 120 has a thickness of less than 2500 Å”), Fig. 3 (step 304, “Deposit resist layer of less than 2500 Å over hardmask”). These disclosures establish that resist films with thicknesses under 2500 Å qualify as UTR layers. They do not, however, establish the upper limit of the thickness of UTR layers.

52. The ’097 patent’s discussion of thicknesses other than “less than 2500 Å” also does not establish the upper limit of the thickness of UTR layer. The patent describes a “standard” resist thickness of 5000 Å or more for 248 nm lithography and of 4000 Å for 193 nm lithography.[1] ’097 patent at 1:39–43 (“In the current state-of-the-art, integrated circuit manufacturers have been using in the resist process a resist coating having a standard photoresist thickness of more than 0.5 µm (5,000 Å) for 248 nm lithography and 0.4 µm (4,000 Å) for 193 nm lithography.”), 2:29–31 (“FIGS. 1(a)-1(d) illustrate cross-sectional views of a conventional lithographic process utilizing a standard resist having a thickness of about 5000 Å”), 2:51–58 (“Before describing in detail the improved method… first explaining the conventional lithographic process used on a standard resist having a thickness of about 5000 Å for forming a gate conductor with reference to FIGS. 1(a) through 1(d).”), 3:2–3 (“The resist layer has a thickness of approximately 5000 Å in the current art.”), Fig. 1a. Thus, the patent discloses that the “standard” resist thickness varies depending on the wavelength of light used during a lithography process: the standard resist thickness is larger for 248 nm lithography (5000 Å or more) than it is for 193 nm lithography (4000 Å). ’097 patent

[1] The figures of 248 nm and 193 nm refer to the wavelengths of light used for patterning photoresist.

at 1:39–43, 2:29–31, 2:51–58, 3:2–3, Fig. 1a. These disclosures are consistent with the knowledge of a POSITA, namely that the absorption of light by a photoresist increases as the wavelength used for photolithography decreases, such that thinner photoresist layers are used at shorter wavelengths. The disclosures and the related understanding about photoresist thickness as a function of lithography wavelength would have suggested to a POSITA that that the thickness range for UTR layer also varies based on the type of lithography being used.

53. The specification does not address what thicknesses between 2500 Å and 5000 Å for 248 nm lithography or between 2500 Å and 4000 Å for 193 nm lithography qualify as "ultra-thin." That is, the specification does not identify the thickness between 2500 Å and 5000 Å that is the upper limit of UTR layer for 248 nm lithography nor the thickness between 2500 Å and 4000 Å that is the upper limit of UTR layer for 193 nm lithography. Thus, the specification, like the claims, does not tell a POSITA the upper limit for thickness of the UTR layer recited in claims 1–3 and 10–17.

54. I reviewed the prosecution history of the '097 patent and found it did not provide any information beyond that provided in the specification and claims as to the upper limit of thickness of UTR layer.

55. Extrinsic evidence does not provide information—missing from the claims, specification, and prosecution history—that removes the uncertainty as to the upper limit of thickness of UTR layer. For example, a POSITA would have been aware that several patents filed shortly before the '097 patent (filed May 2, 2000) and originally assigned, like the '097 patent, to Advanced Micro Devices, Inc. (AMD), use the term UTR layer or a variant such as "ultra-thin photoresist." Five such patents that list as an inventor Scott A. Bell, co-inventor of the '097 patent, disclosed an "ultra-thin photoresist layer" with "a thickness of about 500 Å-5000 Å." U.S. Patent

No. 6,127,070 at 7:19–20; U.S. Patent No. 6,140,023 at 6:15–16; U.S. Patent No. 6,309,926 at 8:34–35; U.S. Patent No. 6,162,587 at 7:22–23; U.S. Patent No. 6,165,695 at 7:31–32. A sixth patent filed a day before the ’097 patent describes that “[u]ltra-thin photoresists . . . have a thickness of about 3,000Å or less.” U.S. Patent No. 6,451,512 at 3:49–50. A seventh patent filed in June 1999 identifies an upper limit for UTR layer thickness that corresponds to yet another value—“about 2500 Å.” U.S. Patent No. 6,156,480 at 3:44–46.

56. Other contemporaneous patents assigned to AMD explain that “[u]ltra-thin resists . . . have a thickness of about 5,000 Å or less.” U.S. Patent No. 6,762,133 at 4:4–5; U.S. Patent No. 6,645,702 at 3:62–64. An additional patent assigned to AMD describes an “ultra thin photoresist layer having a thickness from about 2,000 angstroms to about 5,000 angstroms.” U.S. Patent No. 6,746,973 at 12:55–59. These three patents were filed between July 2001 and August 2002, shortly after the May 2, 2000 filing of the ’097 patent.

57. Other contemporaneous patents listing as an inventor one of the two co-inventors of the ’097 patent identify an upper limit for UTR thickness of 2500 Å. U.S. Patent No. 6,566,214 at 3:49–52 (“2500 Angstroms or less”); U.S. Patent No. 6,326,319 at 1:47–50 (“2,500Å or less”). Scott A. Bell is listed as an inventor of the former patent. Christopher L. Pike is listed as an inventor of the latter patent. These patents were filed between July 2000 and January 2002.

58. The extrinsic evidence discussed above confirms that at the time of the invention, the upper limit on the thickness of UTR could have been one of several different values, such as 5000 Å, 3000 Å, or 2500 Å. Thus, the upper limit on the thickness of UTR was not a well-defined quantity in the art. As a result, a POSITA encountering the term UTR layer would have been obliged to seek a specific teaching within the disclosure to determine its upper limit. However, nothing in the ’097 patent claims, specification, or prosecution history provides that specific

teaching. Accordingly, a POSITA would have been unable to determine the upper limit of thickness for the term UTR layer in claims 1-3 and 10-17.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 6, 2021.

SIGNATURE

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Costas J. Spanos

EXHIBIT 1

Costas J. Spanos

Andrew S. Grove Distinguished Professor
Electrical Engineering and Computer Sciences
University of California, Berkeley CA 94720-1770
spanos@berkeley.edu, 510 643 6776

Professional History

- **Department of EECS**

  Jul 95 – present Professor of Electrical Engineering and Computer Sciences
  Jul 91 - Jun 95 Associate Professor of Electrical Engineering and Computer Sciences
  Jul 88 - Jun 91 Assistant Professor of Electrical Engineering and Computer Sciences

  - Specializing in Computer-Aided Manufacturing systems and Design for Manufacturing applications for Integrated Circuits. Founding co-PI of multi-investigator, multi-campus centers, supported by multiple companies and the state of California. PI or co-PI on several industrially funded research projects.
  - Specializing in Energy Efficiency. Founding Principal Investigator of multinational, multidisciplinary project on energy efficient buildings including University of California Berkeley, Nanyang Technological University and National University of Singapore, funded by Singapore's National Research Foundation.

- **Director, Center for Information Technology Research in the Interest of Society & the Banatao Institute since 2014**
  - The Center for Information Technology Research in the Interest of Society (CITRIS) was formed in 2001, when researchers within the UC system realized that the real opportunities lay not just in *developing* new and innovative technologies, but also in *applying* them towards societal goals.
  - CITRIS was established to address the most pressing social and environmental issues facing California. To meet this goal, we presently focus our research on several core efforts including Sustainable Infrastructures, Health, People & Robots, the Policy Lab, the Future of Work, and the Women in Tech initiative.

- **Associate Dean for Strategic Initiatives, College of Engineering, 2013 – 2014**
  - Oversaw the College's international collaborations including Singapore, China, and the Philippines, while exploring new prospects in places such as Brazil and Mexico.
  - Joint research programs, opportunities for COE and UCB to participate and lead the development of novel initiatives, and opportunities for our faculty to engage in targeted executive education programs.

- **Founding Director & CEO, Berkeley Educational Alliance for Research in Singapore, 2011 – 2014, 2018 – present**
- **CTO, Berkeley Educational Alliance for Research in Singapore 2014 - 2018**
  - BEARS is the umbrella organization that manages UC's large research programs in Singapore on Energy, which has secured over $120M in funding.
  - As its founding Director, oversaw built out and operations, including the interaction with the BEARS Governing Board and Singapore's National Research Foundation.

  - Leading a broad outreach effort for both corporate and institutional relationships in Singapore and worldwide.

- **EECS Department Chair, 2010- 2012**

  - Oversaw academic personnel, outreach and overall functions and operations for the largest academic department at the University of CA, Berkeley. (85 Regular faculty, 530 graduate students, 1, 200 undergraduate students, ~100M annual research budget. The EECS Department has been consistently rated within the top 3 worldwide in all of our graduate and undergraduate programs.
  - Handled major reorganization in view of dramatically changing CA state budgets.
  - Attracted a major donation by Texas Instruments for the improvement of Cory Hall.

- **EECS Associate Chair, Chair of the EE Division, 2008 – 2010**

  - Oversaw academic personnel actions within the Electrical Engineering Division the EECS Department, worked with Dept. Chair (Professor Stuart Russell) in overall department outreach, strategy and operations.

- **Associate Dean for Research in the College of Engineering, 2004 –2008**

  - Oversaw the ~150M/year Research Enterprise in the College of Engineering.
  - Reorganized four Organized Research Units into the Engineering Research Support Organization (ERSO), recruited its senior leadership and oversaw its operation. ERSO employed about 100 staff and handled the research grants within the College of Engineering. It has now grown into a major Shared-Services unit and is the model for the new "regional" redevelopment across campus. (http://www.erso.berkeley.edu/)
  - Drove large programmatic development projects bringing together various faculty constituencies and potential sponsors.
  - Managed matching funds for developing research proposals in strategic areas.
  - Led the effort to streamline industrial support across the College.
  - Participated in numerous campus initiatives relating to research support policies and infrastructure (i.e. Academic Senate Task Force on Industrial Support, Campus Technology Council, Committee to streamline interaction between Berkeley campus and Lawrence Berkeley Laboratory, etc.).

- **Other Appointments**

  - Co-chief Scientist, C3.ai Digital Transformation institute since April 2020.
  - Berkeley Lead, Siebel Energy Institute, 2015-2020.
  - Advisor to Intellectual Ventures on international development projects in Energy Infrastructure, 2013-2014.
  - Program Committee, SPIE conference in Advanced Lithography, 2012- 2014.
  - Advisor to KLA-Tencor on Wireless Metrology, 2007-2014.
  - Intellectual Property Expert for Spansion Japan and Spansion US, 2010.
  - Trade Secret Expert for Taiwan Semiconductor Manufacturing Corporation, 2009.

- Advisor to the United Nations Development Programme on the Sustainable Growth Strategy for the Southeast Anatolia Region, Turkey, 2009-2010.
- Advisor to the Energy Free Home Challenge for the Siebel Foundation 2007-2009.
- Co-Founder, and CEO, OnWafer Technologies (2000-2002), Chief Technology Advisor and Chairman (2003-2007) until OnWafer's acquisition by KLA-Tencor.
- Co-Inventor and Technology Advisor, Timbre Tech (1999-2001), until acquisition by Tokyo Electron.
- Member of the Technical Advisory Board, PDF Solutions.
- Director of the Electronics Research Laboratory 2004 - 2005.
- Intellectual Property Expert for Texas Instruments 1998-2000.
- Founding PI, multi-campus "Small Feature Reproducibility" project 1998- 2003.
- Director of the Berkeley Microfabrication Laboratory 1993-2000.
- Editor of the IEEE Journal "Transactions on Semiconductor Manufacturing"1991-1994. Principal Software Engineer, Digital equipment Corporation 1987-1988
- Senior Software Engineer, Digital equipment Corporation 1985-1987

Education

- May 85, Ph.D. in Electrical Engineering, specialized in Computer-Aided Fabrication of ICs. Carnegie Mellon University, Pittsburgh, PA.

  Thesis subject: Statistical IC Process Characterization.
  Thesis advisor: Professor S. W. Director.

- July 81, M.S. in Electrical Engineering, specialized in Computer-Aided Design of ICs. Carnegie Mellon University, Pittsburgh, PA.

  Thesis subject: Techniques for bi-Objective Decision Making.
  Thesis advisor: Professor S. W. Director.

- June 80, Diploma (5 years) in Electrical Engineering, specialized in Electronics. National Technical University of Athens, Greece.

  Thesis subject: Hybrid Computer Communication Protocols.
  Thesis advisor: Professor E. N. Protonotarios

Honors, Awards

- 1977 and 1979 Greek Institute of State Scholarships Awards.
- 1992 International Semiconductor Manufacturing Science Symposium Best Paper Award
- 1997, 2001, 2005, 2007 IEEE Transactions in Semiconductor Manufacturing Best Paper Awards
- 2008 AEC/APC Best student paper award (with Jing Xue).
- 2013 CASE Best application paper award (with Kevin Weekly).
- 2015 UBICOMM Best paper award (with Ming Jin).
- Fellow of the IEEE, class of 2000.
- Holder of the Andrew S. Grove Distinguished Professorship in EECS since 2009.
- 2016 UC Berkeley Graduate Assembly Faculty Mentor Award.
- 2018 Building and Environment Best Paper Award.

Textbook

Fundamentals of Semiconductor Manufacturing and Process Control" by Gary S. May and Costas J. Spanos, Wiley Interscience, 2006.

Refereed Journal Publications

1. Costas J. Spanos and S. W. Director, "Parameter Extraction for Statistical IC Process Characterization", IEEE Trans. on CAD Vol. CAD-5 No 1, pp. 66-79, January 1986
2. Costas J. Spanos, "Statistical Significance of Error-Corrupted IC Measurements", IEEE Trans. on Semiconductor Manufacturing Vol. 2 No 1, pp. 23-27, February 1989.
3. K. K. Lin and Costas J. Spanos, "Statistical Equipment Modeling for VLSI Manufacturing: An Application for LPCVD", IEEE Trans. on Semiconductor Manufacturing Vol. 3, No 4, pp. 216-30, November 1990.
4. N. H. Chang and Costas J. Spanos, "Continuous Equipment Diagnosis Using Evidence Integration: An Application for LPCVD", IEEE Trans. on Semiconductor Manufacturing Vol. 4 No 1, pp. 43-51, February 1991.
5. G.S. May, Costas J. Spanos and J. Huang, "Statistical Experimental Design in Plasma Etch Modeling", IEEE Trans. on Semiconductor Manufacturing Vol-4 No 2, pp. 83-99, May 1991.
6. Costas J. Spanos, "Statistical Process Control in Semiconductor Manufacturing", Proceedings of the IEEE, Vol. 80, No. 6, pp. 819-30, June 1992.
7. Costas J. Spanos, Haifang Guo, Alan Miller and Joanne Levine-Parrill, "Real-Time Statistical Process Control Using Tool Data", IEEE Trans. on Semiconductor Manufacturing, Vol. 5, No 4, pp. 308-18, November 1992.
8. G. S. May and Costas J. Spanos, "Automated Malfunction Diagnosis of Semiconductor Fabrication Equipment: A Plasma Etch Application", IEEE Trans. on Semiconductor Manufacturing, Vol. 6, No 1, pp. 28-40, February 1993.
9. E. Boskin, Costas J. Spanos, G. Korsh, "A Method for Modeling the Manufacturability of IC Designs", IEEE Trans. on Semiconductor Manufacturing, Vol. 7, No 3, pp. 298-305, August 1994.
10. S. Lee and Costas J. Spanos, "RTSPC: A Software Utility for Real-Time SPC and Tool Data Analysis", IEEE Trans. on Semiconductor Manufacturing, Vol. 8, No 1, pp. 17-25, February 1995.
11. C. Yu, T. Maung, Costas J. Spanos, D. Boning, J. Chung, H-Y Liu, K-J Chang and D. Bartelink, "Use of Short-Loop Electrical Measurements for Yield Improvement", IEEE Trans. on Semiconductor Manufacturing, Vol. 8, No 2, pp. 150-159, May 1995.
12. S. Cunningham, Costas J. Spanos, K. Voros, "Semiconductor Yield Improvement: Results and Best Practices", IEEE Trans. on Semiconductor Manufacturing, Vol. 8, No 2, pp. 103-109, May 1995.
13. S. Lee and Costas J. Spanos, "Prediction of Wafer State After Plasma Processing Using Real-Time Tool Data", IEEE Trans. on Semiconductor Manufacturing, Vol 8, No 2, pp. 252-61, August 1995.
14. S. Leang and Costas J. Spanos, "A Novel In-line Automated Metrology for Photolithography", IEEE Trans. on Semiconductor Manufacturing, Vol 9, No 1, pp. 101-7, February 1996.
15. Crid Yu, Costas J. Spanos, Hua Yu Liu and Dirk Bartelink, "Lithography Error Sources Quantified by Statistical Metrology", Solid State Technology, February 1996.

16. S. Leang, S-Y Ma, J. Thomson, B. Bombay and Costas J. Spanos, “A Control System for Photolithographic Sequences”, IEEE Trans. on Semiconductor Manufacturing, Vol 9, No 2, pp. 191-207, May 1996.
17. E. Palmer, W. Ren, Costas J. Spanos and K. Poolla, “Control of Photoresist Properties: A Kalman Filter Based Approach”, IEEE Trans. on Semiconductor Manufacturing, Vol 9, No 2, pp. 208-14, May 1996.
18. Roawen Chen, Herb Huang, Costas J. Spanos, Michael Gatto, “Plasma Etch Modeling Using Optical Emission Spectroscopy”, Journal of Vacuum Science Technology, A 14(3), May/ June 1996.
19. Antonio J. Miranda and Costas J. Spanos, “Impedance Modeling of a Cl2/He Plasma Discharge”, Journal of Vacuum Science Technology, A 14(3), May/June 1996.
20. Crid Yu, H.-Y. Liu and Costas J. Spanos, “Patterning Tool Characterization by Causal Variability Decomposition”, IEEE Trans. on Semiconductor Manufacturing, Vol 9, No 4, pp. 527-35, November 1996.
21. Costas J. Spanos and R. Chen, “Qualitative Modeling for Process Control in Semiconductor Manufacturing”, IEEE Trans. on Semiconductor Manufacturing, Vol 10, No 2, pp. 307-16, May 1997.
22. S. Leang and Costas J. Spanos, “A General Equipment Diagnosis System and its Application on Photolithographic Sequences”, IEEE Trans. on Semiconductor Manufacturing, Vol 10, No 3, pp. 329-43, August 1997 (Best Paper Award)
23. Zhihao Lin, Member, IEEE, Costas J. Spanos, Senior Member, IEEE, Linda S. Milor, Member, IEEE, and Y. T. Lin, “Circuit Sensitivity to Interconnect Variation”, IEEE Trans. on Semiconductor Manufacturing, Vol. 11, No. 4, pp. 557-68, November 1998
24. Xinhui Niu, Nickhil Jakatdar, Junwei Bao, Costas J. Spanos, “Specular Spectroscopic Scatterometry”, IEEE Trans. on Semiconductor Manufacturing, Vol. 14, No. 2, pp. 97-111, May, 2001. (Best Paper Award)
25. Mason Freed, Michiel Kruger, Costas J. Spanos and Kameshwar Poolla, “Autonomous on-wafer sensors for process modeling, diagnosis, and control”, IEEE Trans. on Semiconductor Manufacturing, Vol. 14, No. 3, pp. 255-264, Aug, 2001.
26. Jiangxin Wang and Costas J. Spanos, “Real Time Furnace Modeling and Diagnostics”, IEEE Trans. on Semiconductor Manufacturing, Vol. 15, No. 4, pp. 393-403, November 2002.
27. Payman Jula, Costas J. Spanos, Fellow, IEEE, and Robert C. Leachman, “Comparing the Economic Impact of Alternative Metrology Methods in Semiconductor Manufacturing”, IEEE Trans. on Semiconductor Manufacturing, Vol. 15, No. 4, pp. 454-63, November 2002.
28. Runzi Chang, Member, IEEE, Yu Cao, Member, IEEE, and Costas J. Spanos, Fellow, IEEE, “Modeling the Electrical Effects of Metal Dishing Due to CMP for On-Chip Interconnect Optimization”, IEEE Transactions on Electron Devices, vol. 51, NO. 10, OCTOBER 2004
29. Freed, M.; Kruger, M.V.P.; Poolla, K.; Costas J. Spanos. “Wafer-grown heat flux sensor arrays for plasma etch processes”IEEE Transactions on Semiconductor Manufacturing, Volume 18, Issue 1, Feb 2005 Page(s):148 - 162 (Best Paper Award)
30. Runzi Chang and Costas J. Spanos, “Dishing-radius model of copper CMP dishing effects”, IEEE Transactions on Semiconductor Manufacturing, Volume 18, Issue 2, May 2005 Page(s):297 - 303
31. Jason P. Cain, Patrick P. Naulleau, Eric M. Gullikson, Costas J. Spanos, “Lithographic characterization of the flare in the Berkeley 0.3 numerical aperture extreme ultraviolet

microfield optic", Journal of Vacuum Science Technology B, Vol. 24, No. 3, pp 1234-7, May/June 2006

32. Qiaolin Zhang; Poolla, K.; Spanos, C.J.;, "Across Wafer Critical Dimension Uniformity Enhancement Through Lithography and Etch Process Sequence: Concept, Approach, Modeling, and Experiment"IEEE Transactions on Semiconductor Manufacturing, Volume 30, Issue 4, Nov 2007 Page(s):488 – 505 (Best Paper Award)
33. Liang-Teck Pang; Kun Qian; Spanos, C.J.; Nikolic, B., "Measurement and Analysis of Variability in 45 nm Strained-Si CMOS Technology"IEEE Journal of Solid-State Circuits, Volume 44, Issue 8, Aug. 2009 Page(s): 2233 – 2243
34. Dekong Zeng; Spanos, C.J.; , "Virtual Metrology Modeling for Plasma Etch Operations,"IEEE Transactions on Semiconductor Manufacturing, vol.22, no.4, pp.419-431, Nov. 2009
35. Patel, K.; Tsu-Jae King Liu; Spanos, C.J.; , "Gate Line Edge Roughness Model for Estimation of FinFET Performance Variability,"IEEE Transactions on Electron Devices, vol.56, no.12, pp.3055-3063, Dec. 2009
36. Patel, Kedar; Lahiri, Soumendra N.; Spanos, Costas J.; , "Robust estimation of line width roughness parameters,"Journal of Vacuum Science & Technology B: Microelectronics and Nanometer Structures , vol.28, no.6, pp.C6H18-C6H33, Nov 2010
37. Lerong Cheng; Gupta, P.; Spanos, C.J.; Kun Qian; Lei He; , "Physically Justifiable Die-Level Modeling of Spatial Variation in View of Systematic Across Wafer Variability,"IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, vol.30, no.3, pp.388-401, March 2011
38. Jae Yeon Baek; Spanos, C.J., "Performance Evaluation of Blended Metrology Schemes Incorporating Virtual Metrology,"*Semiconductor Manufacturing, IEEE Transactions on* , vol.26, no.4, pp.506,515, Nov. 2013
39. Kai Ma; Guoqiang Hu; Spanos, C.J., "Distributed Energy Consumption Control via Real-Time Pricing Feedback in Smart Grid," *Control Systems Technology, IEEE Transactions on* , vol.22, no.5, pp.1907,1914, Sept. 2014
40. Ma, K.; Hu, G.; Spanos, C.J., "A Cooperative Demand Response Scheme Using Punishment Mechanism and Application to Industrial Refrigerated Warehouses," *Industrial Informatics, IEEE Transactions on* , vol.PP, no.99, pp.1,1. May 2015
41. Weekly, K., N. Bekiaris-Liberis, Jin, M., and A. M. Bayen, "Modeling and Estimation of the Humans' Effect on the CO_2 Dynamics Inside a Conference Room". IEEE Transactions on Control Systems Technology, (TCST) (99), 1–1, 2015.
42. Ma, Kai; Hu, Guoqiang; Spanos, Costas J; "Energy Management Considering Load Operations and Forecast Errors with Application to HVAC Systems IEEE Transactions on Smart Grid 2016
43. Li, Dan; Zhou, Yuxun; Hu, Guoqiang; Spanos, Costas J; "Fault detection and diagnosis for building cooling system with a tree-structured learning method Energy and Buildings 127 540-551 2016 Elsevier
44. Li, Dan; Hu, Guoqiang; Spanos, Costas J; "A data-driven strategy for detection and diagnosis of building chiller faults using linear discriminant analysis Energy and Buildings 128 519-529 2016 Elsevier

45. Poon, Jason; Jain, Palak; Spanos, Costas; Panda, Sanjib Kumar; Sanders, Seth R; "Fault Prognosis for Power Electronics Systems Using Adaptive Parameter Identification", IEEE Transactions on Industry Applications 53 3 2862-2870 2017
46. Xu, Zhanbo; Liu, Shuo; Hu, Guoqiang; Spanos, Costas J; "Optimal coordination of air conditioning system and personal fans for building energy efficiency improvement Energy and Buildings", 141 308-320 2017 Elsevier
47. Jin, Ming; Jia, Ruoxi; Spanos, Costas; "Virtual occupancy sensing: Using smart meters to indicate your presence IEEE Transactions on Mobile Computing", 2017
48. Zhou, Yuxun; Arghandeh, Reza; Spanos, Costas J; "Partial Knowledge Data-driven Event Detection for Power Distribution Networks", IEEE Transactions on Smart Grid 2017
49. Konstantakopoulos, Ioannis C; Ratliff, Lillian J; Jin, Ming; Sastry, S Shankar; Spanos, Costas J; "A Robust Utility Learning Framework via Inverse Optimization", IEEE Transactions on Control Systems Technology 2017
50. Zou, Han; Jin, Ming; Jiang, Hao; Xie, Lihua; Spanos, Costas J; "WinIPS: WiFi-based non-intrusive indoor positioning system with online radio map construction and adaptation", IEEE Transactions on Wireless Communications 16 12 8118-8130 2017 IEEE
51. Xu, Zhanbo; Hu, Guoqiang; Spanos, Costas J; "Coordinated optimization of multiple buildings with a fair price mechanism for energy exchange", Energy and Buildings 151 132-145 2017 Elsevier
52. Xu, Zhanbo; Hu, Guoqiang; Spanos, Costas J; Schiavon, Stefano; "PMV-based event-triggered mechanism for building energy management under uncertainties", Energy and Buildings 2017 Elsevier
53. Jin, Ming; Feng, Wei; Liu, Ping; Marnay, Chris; Spanos, Costas; "MOD-DR: Microgrid optimal dispatch with demand response", Applied Energy 187 758-776 2017 Elsevier
54. Xu, Zhanbo; Liu, Shuo; Hu, Guoqiang; Spanos, Costas J; "Optimal coordination of air conditioning system and personal fans for building energy efficiency improvement", Energy and Buildings 141 308-320 2017 Elsevier
55. Zou, Han; Jiang, Hao; Yang, Jianfei; Xie, Lihua; Spanos, Costas; "Non-intrusive occupancy sensing in commercial buildings", Energy and Buildings 154 633-643 2017 Elsevier
56. Li, Dan; Zhou, Yuxun; Hu, Guoqiang; Spanos, Costas J; "Identifying Unseen Faults for Smart Buildings by Incorporating Expert Knowledge With Data", IEEE Transactions on Automation Science and Engineering 2018 IEEE
57. Nguyen, Linh V; Hu, Guoqiang; Spanos, Costas J; Efficient Sensor Deployments for Spatio-Temporal Environmental Monitoring IEEE Transactions on Systems, Man, and Cybernetics: Systems 2018 IEEE
58. Sangogboye, Fisayo Caleb; Jia, Ruoxi; Hong, Tianzhen; Spanos, Costas; Kjærgaard, Mikkel Baun; A Framework for Privacy-Preserving Data Publishing with Enhanced Utility for Cyber-Physical Systems ACM Transactions on Sensor Networks (TOSN) 14 3-4 30 2018 ACM
59. Jia, Ruoxi; Jin, Baihong; Jin, Ming; Zhou, Yuxun; Konstantakopoulos, Ioannis C; Zou, Han; Kim, Joyce; Li, Dan; Gu, Weixi; Arghandeh, Reza; Spanos, Costas J; Design automation for smart building systems Proceedings of the IEEE 106 9 1680-1699 2018 IEEE
60. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Spanos, Costas J; Unsupervised WiFi-enabled IoT Device-User Association for Personalized Location-based Service IEEE Internet of Things Journal 2018 IEEE

61. Kandasamy, Nandha Kumar; Karunagaran, Giridharan; Spanos, Costas; Tseng, King Jet; Soong, Boon-Hee; Smart lighting system using ANN-IMC for personalized lighting control and daylight harvesting Building and Environment 139 170-180 2018 Pergamon
62. Muñoz-Carpintero, Diego; Hu, Guoqiang; Spanos, Costas J; Stochastic Model Predictive Control with adaptive constraint tightening for non-conservative chance constraints satisfaction Automatica 96 32-39 2018 Pergamon
63. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Spanos, Costas J; Device-free occupancy detection and crowd counting in smart buildings with WiFi-enabled IoT Energy and Buildings 174 309-322 2018 Elsevier
64. Ma, Kai; Hu, Guoqiang; Spanos, Costas J; Energy management considering load operations and forecast errors with application to HVAC systems IEEE Transactions on Smart Grid 9 2 605-614 2018 IEEE
65. Konstantakopoulos, I; Ratliff, Lillian J; Jin, Ming; Sastry, S Shankar; Spanos, Costas J; Robust utility learning with applications to Social Games in Smart Buildings IEEE Trans. Control Syst. Technol 2018
66. Jin, Ming; Bekiaris-Liberis, Nikolaos; Weekly, Kevin; Spanos, Costas J; Bayen, Alexandre M; Occupancy detection via environmental sensing IEEE Transactions on Automation Science and Engineering 15 2 443-455 2018 IEEE
67. Zhou, Yuxun; Arghandeh, Reza; Spanos, Costas J; Partial knowledge data-driven event detection for power distribution networks IEEE Transactions on Smart Grid 9 5 5152-5162 2018 IEEE
68. Konstantakopoulos, Ioannis C; Ratliff, Lillian J; Jin, Ming; Sastry, S Shankar; Spanos, Costas J; A robust utility learning framework via inverse optimization IEEE Transactions on Control Systems Technology 26 3 954-970 2018 IEEE
69. Jin, Ming; Feng, Wei; Marnay, Chris; Spanos, Costas; Microgrid to enable optimal distributed energy retail and end-user demand response Applied Energy 210 1321-1335 2018 Elsevier
70. Zou, Han; Zhou, Yuxun; Jiang, Hao; Chien, Szu-Cheng; Xie, Lihua; Spanos, Costas J; WinLight: A WiFi-based occupancy-driven lighting control system for smart building Energy and Buildings 158 924-938 2018 Elsevier
71. Jin, Ming; Liu, Shichao; Schiavon, Stefano; Spanos, Costas; Automated mobile sensing: Towards high-granularity agile indoor environmental quality monitoring Building and Environment 127 268-276 2018 Pergamon
72. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Spanos, Costas J; Towards occupant activity driven smart buildings via WiFi-enabled IoT devices and deep learning Energy and Buildings 177 12-22 2018 Elsevier
73. Zhou, Yuxun; Arghandeh, Reza; Zou, Han; Spanos, Costas J; Nonparametric Event Detection in Multiple Time Series for Power Distribution Networks IEEE Transactions on Industrial Electronics 66 2 1619-1628 2019 IEEE
74. Konstantakopoulos, Ioannis C; Barkan, Andrew R; He, Shiying; Veeravalli, Tanya; Liu, Huihan; Spanos, Costas; A deep learning and gamification approach to improving human-building interaction and energy efficiency in smart infrastructure, Applied Energy 237 810-821 2019 Elsevier
75. HP Das, M Jin, CJ Spanos Personal thermal comfort models with wearable sensors, S Liu, S Schiavon, , Building and Environment 162, 106281, 2019
76. P Jain, J Poon, JP Singh, C Spanos, S Sanders, SK Panda, A Digital Twin Approach for Fault Diagnosis in Distributed Photovoltaic System IEEE Transactions on Power Electronics, 2019

77. P Jain, J Poon, JP Singh, C Spanos, S Sanders, SK Panda, Multiple Kernel Semi-representation Learning with Its Application to Device-Free Human Activity Recognition, H Zou, Y Zhou, R Arghandeh, CJ Spanos, IEEE Internet of Things Journal 2019
78. Jia, Ruoxi; Jin, Ming; Sun, Kaiyu; Hong, Tianzhen; Spanos, Costas; Advanced Building Control via Deep Reinforcement Learning , Energy Procedia158 6158-6161, 2019, Elsevier
79. M Jin, R Jia, HP Das, W Feng, C Spanos, BISCUIT: Building intelligent system customer investment tools, Energy Procedia 158, 6152-6157, 2019, Elsevier
80. Sultan, Zuraimi; Spanos, Costas; Goh, Edwin; Ping, Gao Chun; Sapar, Majid; ,Living Lab Integrates IEQ Technologies in Singapore, ASHRAE Journal,62, 2,68-72, 2020,American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc.
81. Yang, Yu; Hu, Guoqiang; Spanos, Costas J, HVAC Energy Cost Optimization for a Multizone Building via a Decentralized Approach, IEEE Transactions on Automation Science and Engineering, 2020, IEEE
82. Liu, Shichao; Schiavon, Stefano; Das, Hari Prasanna; Jin, Ming; Spanos, Costas J; ,Personal thermal comfort models with wearable sensors, Building and Environment,162,106281, 2019, Pergamon
83. Li, Dan; Zhou, Yuxun; Hu, Guoqiang; Spanos, Costas J; ,Handling Incomplete Sensor Measurements in Fault Detection and Diagnosis for Building HVAC Systems,IEEE Transactions on Automation Science and Engineering,17, 2, 833-846, 2019, IEEE
84. He, Miao; Gu, Weixi; Kong, Ying; Zhang, Lin; Spanos, Costas J; Mosalam, Khalid M; ,CausalBG: Causal Recurrent Neural Network for the Blood Glucose Inference with IoT Platform,IEEE Internet of Things Journal,7,1,598-610, 2019,IEEE
85. Yang, Yu and Hu, Guoqiang and Spanos, Costas J, HVAC Energy Cost Optimization for a Multizone Building via a Decentralized Approach, IEEE Transactions on Automation Science and Engineering, 17, 4, 1950--1960, 2020, IEEE
86. Jin, Ming and Jain, Rishee and Spanos, Costas and Jia, Qingshan and Norford, Leslie K and Kjaergaard, Mikkel and Yan, Jinyue, Energy-cyber-physical systems, Applied Energy, 256, 113939, 2019, Pergamon Press
87. Tekler, Zeynep Duygu and Low, Raymond and Zhou, Yuren and Yuen, Chau and Blessing, Lucienne and Spanos, Costas,Near-real-time plug load identification using low-frequency power data in office spaces: Experiments and applications, Applied Energy, 275, 115391, 2020, Elsevier
88. Radhakrishnan, Krishnanand Kaippilly and Chinh, Hoang Duc and Gupta, Manish and Panda, Sanjib Kumar and Spanos, Costas J, Context-Aware Plug-Load Identification Toward Enhanced Energy Efficiency in the Built Environment, IEEE Transactions on Industry Applications, 56, 6, 6781--6791, 2020, IEEE
89. Periyakoil, Divya and Das, Hari Prasanna and Miller, Clayton and Spanos, Costas J and Prata, Ndola, Environmental Exposures in Singapore Schools: An Ecological Study, International journal of environmental research and public health, 18, 4, 1843, 2021, Multidisciplinary Digital Publishing Institute
90. Sultan, Zuraimi and Spanos, Costas and Goh, Edwin and Ping, Gao Chun and Sapar, Majid, Living Lab Integrates IEQ Technologies in Singapore, ASHRAE Journal, 62, 2, 68--72, 2020, American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc.
91. Yang, Yu and Srinivasan, Seshadhri and Hu, Guoqiang and Spanos, Costas J, Distributed Control of Multizone HVAC Systems Considering Indoor Air Quality, IEEE Transactions on Control Systems Technology, 2021, IEEE

92. Zou, Han and Chen, Chun-Lin and Li, Maoxun and Yang, Jianfei and Zhou, Yuxun and Xie, Lihua and Spanos, Costas J, Adversarial learning-enabled automatic WiFi indoor radio map construction and adaptation with mobile robot, IEEE Internet of Things Journal, 7, 8, 6946--6954, 2020, IEEE
93. Yang, Yu and Hu, Guoqiang and Spanos, Costas J, Stochastic optimal control of HVAC system for energy-efficient buildings, IEEE Transactions on Control Systems Technology, 2021, IEEE

Refereed Conference Publications

94. E. N. Protonotarios, Costas J. Spanos, E. Sykas and G. Kamarinos, "Hybrid Protocols for Computer Communication Networks", MELECON Proceedings, Israel, 1980.
95. Costas J. Spanos and S. W. Director, "Prometheus: a method for VLSI process characterization", ICCAD proceedings, Santa Clara CA, November 1983.
96. Costas J. Spanos, "Hippocrates: a methodology for IC process diagnosis", ICCAD proceedings, Santa Clara CA, November 1986.
97. D. A. Hodges, L. A. Rowe and Costas J. Spanos, "Computer Integrated Manufacturing", International Electronics Manufacturing Technology Symposium, San Francisco CA, September 1989.
98. K. K. Lin, J. Huang and Costas J. Spanos, "Statistical Equipment Modeling for VLSI Manufacturing", Meeting of the Electrochemical Society, Hollywood, Florida, October 1989.
99. J. Huang, K. K. Lin, J. Lau, D. A. Hodges, Costas J. Spanos, G. C. Johnson and R. T. Howe, "Texture of Undoped LPCVD Polycrystalline Silicon Films", ASM Int. Symp. Textures in Non-Metallic Materials, Indianapolis, Indiana, October 1989.
100. J. Huang, K. K. Lin, Costas J. Spanos, D. A. Hodges, G. C. Johnson and R. T. Howe, "Polysilicon Process Characterization for Microstructural Applications", ASM Int. Symp. Textures in Non- Metallic Materials, Indianapolis, Indiana, October 1989.
101. N. H. Chang and Costas J. Spanos, "Chronological Equipment Diagnosis Using Evidence Integration", SPIE conference on Applications of Artificial Intelligence VIII, Orlando, Florida, April 1990.
102. N. H. Chang and Costas J. Spanos, "Continuous Diagnosis of Low-Pressure Chemical Vapor Deposition Reactors using Evidence Integration", IEEE Symposium on VLSI Technology, Honolulu, Hawaii, June 1990.
103. K. K. Lin and Costas J. Spanos, "Computer-Aided Design of LPCVD Recipes", IEEE/SEMI Advanced Semiconductor Manufacturing Conference and Workshop, Danvers MA, September 1990.
104. Z. M. Ling, S. Leang and Costas J. Spanos, "A Lithography Workcell Monitoring and Modeling Scheme", Microcircuit Engineering Conference, Leuven, Belgium, ME 13 (1991) pp. 537- 540, September 1990.
105. G. S. May, J. Huang and Costas J. Spanos, "Experimental Modeling of the Etch Characteristics of Polysilicon in CCl_4 / He / O_2 Plasmas", 9th IEEE/CHMT International Electronics Manufacturing Technology Symposium, Washington DC, October 1990.

106. Z. M. Ling, S. Leang and Costas J. Spanos, “In-line Supervisory Control in a Photolithography Workcell”, SPIE Symposium on Microelectronics Processing Integration, Santa Clara, CA, October 5 1990.
107. Z. M. Ling and Costas J. Spanos, “A Novel Approach for Film Reflectance Measurement and its Application for the Control of a Photolithography Workcell”, 178th Meeting of the Electrochemical Society, Seattle, Washington, October 17 1990.
108. E. D. Boskin and Costas J. Spanos, “Worst Case Device Characterization for Statistical Circuit Design”, SRC Techcon, San Jose, CA, October 17 1990.
109. T. Luan, G. S. May and Costas J. Spanos, “Manufacturing-Based IC Process and Device Simulation”, SRC Techcon, San Jose, CA, October 17 1990.
110. G. S. May and Costas J. Spanos, “Automated Malfunction Diagnosis of a Plasma Etcher”, International Semiconductor Manufacturing Sciences Symposium, San Mateo, CA, May 20-22, 1991.
111. H. F. Guo, Costas J. Spanos and A. J. Miller, “Real-time Statistical Process Control in Plasma Etching”, International Semiconductor Manufacturing Sciences Symposium, San Mateo, CA, May 20-22, 1991.
112. N. N. Tam, H. Y. Liu, Costas J. Spanos and A. R. Neureuther, “A Statistically Based Model of Electron-Beam Exposed, Chemically Amplified Negative Resist”, 35th international Symposium on Electron, Ion & Photon Beams, Seattle WA May 28-31, 1991.
113. B. Bombay and Costas J. Spanos, “The Application of Adaptive Modeling to a Lithographic Process”, SPIE Symposium on Real time Monitoring and Control, September 1991.
114. S. Leang and Costas J. Spanos, “Statistically Based Feedback Control of Photoresist Application”, Advanced Semiconductor Manufacturing Symposium and Workshop, October 1991.
115. E. Boskin, Costas J. Spanos and G. Korsh, “IC Performance Prediction from Electrical Test Measurements”, International Semiconductor Manufacturing Sciences Symposium, San Francisco, CA, June 1992.
116. S. Leang and Costas J. Spanos, “Application of Feed-Forward Control to a Photolithography Stepper”, International Semiconductor Manufacturing Sciences Symposium, San Francisco, CA, June 1992.
117. S. Leang and Costas J. Spanos, “Applying Feed-Forward and Feedback control to a Photolithography Sequence”, Advanced Semiconductor Manufacturing Conference, Boston, MA, October 1992.
118. R. Chen and Costas J. Spanos, “Fuzzy Modeling of Semiconductor Processing Equipment”, Advanced Semiconductor Manufacturing Conference, Boston, MA, October 1992.
119. E. Boskin, Costas J. Spanos and G. Korsh, “A Method for Modeling the Manufacturability of IC Designs”, 1993 IC Modeling and Testing Symposium, Mandrid, Spain, March 1993.
120. S. Cunningham, Costas J. Spanos and J. Shantikumar, “Methods for Yield Improvement in the Semiconductor Industry”, The Institute of Management Sciences and Operations Research Society of America Joint Meeting, Chicago, May 1993.
121. S. Lee and Costas J. Spanos, “Real Time Diagnosis for Plasma Etch Equipment”, 1993 SRC Techcon, September 1993.
122. C. Yu and Costas J. Spanos, “A Manufacturable IC Fabrication Process”, 1993 SRC Techcon, September 1993.

123. R. Chen and Costas J. Spanos, "Statistical Data Pre-processing for Fuzzy Modeling of Semiconductor Manufacturing Process", 3rd International Conference on Industrial; Fuzzy Control & Intelligent Systems, December 1993.
124. S. Lee and Costas J. Spanos, "Experimental Analysis and Wafer Parameter Prediction Using Real-Time Tool Data", presented at the International Symposium on Semiconductor Manufacturing, June 1994.
125. Z. Daoud and Costas J. Spanos, "DORIC: Design of Optimal & Robust Integrated Circuits, Custom Integrated Circuit Conference, May 1994.
126. P. M. Tsai, F. Nadi and Costas J. Spanos, "A Neural Net based, in-line Focus/Exposure Monitor", 1994 Advanced Semiconductor Manufacturing Conference and Workshop, November 1994.
127. Hua-Yu Liu, Crid Yu, Bob Gleason and Costas J. Spanos, "Contributions of Stepper Lenses to Systematic CD Errors Within Exposure Fields", SPIE, Santa Clara, CA, March 1995.
128. Crid Yu and Costas J. Spanos, "Manufacturability Evaluation of Exposure Tools using Statistical Metrology", Stat. Metrology Workshop, Austin, TX, August 1995
129. M. Terrovitis and Costas J. Spanos, "Device Mismatch and its Effect on Common Analog Subcircuits", Stat. Metrology Workshop, Austin, TX, August 1995
130. Crid Yu, Hua-Yu Liu and Costas J. Spanos, "Manufacturability Evaluation of Deep Submicron Exposure Tools Using Statistical Metrology", ISSM, September 1995
131. Roawen Chen, Herb Huang, Costas J. Spanos, Michael Gatto, "Plasma Etch Modeling Using Optical Emission Spectroscopy", 42nd National Symposium of the American Vacuum Society, Minneapolis, MN, October 1995
132. Antonio J. Miranda and Costas J. Spanos, "Impedance Modeling of a Cl2/He Plasma Discharge", 42nd National Symposium of the American Vacuum Society, Minneapolis, MN, October 1995
133. Crid Yu, Anna Minvielle and Costas J. Spanos, "SEM Characterization of Etch and Develop Contributions to Poly CD Error", SPIE, Santa Clara, CA, March 1996.
134. Sean Cunningham and Costas J. Spanos, "Applications of Spatial Statistics to Semiconductor Wafer Defects", First International Statistical Metrology Workshop, Honolulu, Hawaii, June 1996
135. Mark Hatzilambrou, A. Neureuther and Costas J. Spanos, "Ring Oscillator Sensitivity to Spatial Process Variation", First International Statistical Metrology Workshop, Honolulu, Hawaii, June 1996
136. Manolis Terrovitis and Costas J. Spanos, "Process Variability and Device Mismatch", First International Statistical Metrology Workshop, Honolulu, Hawaii, June 1996
137. Crid Yu and Costas J. Spanos, "Contribution of Etch to Metal CD Variability", First International Statistical Metrology Workshop, Honolulu, Hawaii, June 1996
138. X. Niu and Costas J. Spanos, "In-Situ Optical Metrology of Polycrystalline Silicon", Techcon '96, September 1996.
139. R. Chen and Costas J. Spanos, "The Application of In-line Sensors for Plasma Etch in Semiconductor Manufacturing", Techcon '96, September 1996.
140. Anna Ison and Costas J. Spanos, "Accounting for Long Term Trends for Robust Fault Detection of Semiconductor Manufacturing Equipment", Techcon '96, September 1996.
141. Anna Ison and Costas J. Spanos, "Robust Fault Detection and Fault Classification of Semiconductor Manufacturing Equipment", ISSM, Tokyo, October 1996.

142. Roawen Chen and Costas J. Spanos, “CD Monitoring using In-line Sensors”, ISSM, Tokyo, October 1996.
143. Z. Lin, Costas J. Spanos, L. Milor and Y. Lin, “Study of Circuit Sensitivity to Interconnect Variation”, Second International Statistical Metrology Workshop, Kyoto, Japan, June 1997.
144. X. Niu and Costas J. Spanos, “Statistical Enhancement of a Reflectometry Metrology System”, Second International Statistical Metrology Workshop, Kyoto, Japan, June 1997.
145. Roawen Chen and Costas J. Spanos, “Plasma Etch Monitoring with In-Situ Optical Emission Spectroscopy”, AEC/APC Symposium IX, Lake Tahoe, September, 1997.
146. Nickhil Jakatdar and Costas J. Spanos, “Novel METROLOGY FOR THE Photolithography Sequence”, AEC/APC Symposium IX, Lake Tahoe, September, 1997.
147. Anna Ison and Costas J. Spanos, “Fault Detection of Plasma Etch Equipment”, AEC/APC Symposium IX, Lake Tahoe, September, 1997.
148. John Musacchio, Costas J. Spanos and K. Poolla, “On the Utility of Run-to-Run Control in Semiconductor Manufacturing”, Sixth International Symposium on Semiconductor Manufacturing, San Francisco, CA, October, 1997.
149. Anna Ison and Costas J. Spanos, “Fault Diagnosis for Plasma Etch Equipment”, Sixth International Symposium on Semiconductor Manufacturing, San Francisco, CA, October, 1997
150. Sundeep Rangan, Costas J. Spanos and K. Poolla, “Modeling and Filtering Optical Emission Spectroscopy for Plasma Etching Systems”, Sixth International Symposium on Semiconductor Manufacturing, San Francisco, CA, October, 1997
151. Roawen Chen and Costas J. Spanos, “Monitoring Etch Uniformity by Scanning Spatially-Resolved Optical Emission Spectroscopy”, Sixth International Symposium on Semiconductor Manufacturing, San Francisco, CA, October, 1997
152. Nickhil Jakatdar, Xinhui Niu, Costas J. Spanos, “A Neural Network Approach to Rapid Thin Film Characterization”, Flatness, Roughness and Discrete Defects Characterization for Computer Disks, Wafers and Flat Panel Displays II LASE-98 Precision Manufacturing Technologies Photonics West, SPIE, January 1998
153. Xinhui Niu, Nickhil Jakatdar, Costas J. Spanos, Novel DUV Photoresist Modeling by optical thin film decomposition from ellipsometry/reflectometry data”, Flatness, Roughness and Discrete Defects Characterization for Computer Disks, Wafers and Flat Panel Displays II LASE-98 Precision Manufacturing Technologies Photonics West, SPIE, January 1998
154. Nickhil Jakatdar, Xinhui Niu, Costas J. Spanos, Andy Romano, Joe Bendik, John Plummer, Ronald Kovacs, Stephen Hill, “Characterization of a Positive Chemically Amplified Photoresist from the Viewpoint of Process Control for the Photolithography Sequence”, Metrology, Inspection and Process Control for Microlithography XII SPIE's 23rd Annual International Symposium on Microlithography, February 1998
155. Nickhil Jakatdar, Xinhui Niu, Costas J. Spanos, Matt Hankinson, Andy Romano, Joe Bendik, John Plummer, Ronald Kovacs, “In-situ Metrology for Deep Ultraviolet Lithography Process Control”, Metrology, Inspection and Process Control for Microlithography XII SPIE's 23rd Annual International Symposium on Microlithography, February 1998.
156. Nickhil H. Jakatdar, Xinhui Niu, Costas J. Spanos, Andrew R. Romano, Joseph J. Bendik, Ronald P. Kovacs, and Stephen L. Hill, “Characterization of a positive chemically amplified photoresist for process control“, Proc. SPIE Int. Soc. Opt. Eng. 3332, 586 (1998)

157. Nickhil H. Jakatdar, Xinhui Niu, and Costas J. Spanos, “Characterization of a chemically amplified photoresist for simulation using a modified “poor man's DRM”methodology“, Proc. SPIE Int. Soc. Opt. Eng. 3332, 578 (1998)
158. Xinhui Niu, Nickhil Jakatdar, Costas J. Spanos, Joe Bendik, John Plummer, Ronald Kovacs, “Optical thin film decomposition for DUV positive tone resist process monitoring”, Metrology, Inspection and Process Control for Microlithography XII SPIE's 23rd Annual International Symposium on Microlithography, February 1998.
159. Nickhil Jakatdar, Xinhui Niu, Haolin Zhang, Junwei Bao, Costas J. Spanos, “Novel Metrology for the DUV Photolithography Sequence”, International Conference on Characterization and Metrology for ULSI Technology, Washington DC, March 1998 .
160. Haolin Zhang , Costas J. Spanos, “CD-SEM Based Pattern Recognition for Focus/Exposure Control”, AEC/APC Symposium X, Vail, Colorado, October, 1998.
161. N. Jakatdar, X. Niu, J. Musacchio, J. Bao, and Costas J. Spanos, “DUV Lithography Control”, AEC/APC Symposium X, Vail, Colorado, October, 1998.
162. Anna Ison, DongWu Zhao and Costas J. Spanos, “In-sity plasma etch fault Diagnosis using Real-Time and High resolution Sensor Signals”, AEC/APC Symposium X, Vail, Colorado, October, 1998.
163. Nickhil Jakatdar , Junwei Bao, Costas J. Spanos - U.C. Berkeley, Ramkumar Subramanian, Bharath Rangarajan - Advanced Micro Devices, “Physical modeling of deprotection-induced thickness loss“, Metrology, Inspection and Process Control for Microlithography XII SPIE's 24th Annual International Symposium on Microlithography, SPIE February 1999. Proc. SPIE Int. Soc. Opt. Eng. 3678, 275 (1999)
164. Xinhui Niu - Timbre Technology Inc. Nickhil Jakatdar , Junwei Bao, Costas J. Spanos - U.C. Berkeley, Sanjey Yadur - Advanced Micro Devices and SEMATECH, “Specular spectroscopic scatterometry in DUV lithography“, Metrology, Inspection and Process Control for Microlithography XII SPIE's 24th Annual International Symposium on Microlithography, SPIE February 1999. Proc. SPIE Int. Soc. Opt. Eng. 3677, 159 (1999)
165. Nickhil Jakatdar , Junwei Bao, Costas J. Spanos - U.C. Berkeley, Xinhui Niu - Timbre Technology Inc. Joe Bendik - National Semiconductor Corporation, Stephen Hill - Bio-Rad, “Parameter extraction framework for DUV lithography simulation“, Metrology, Inspection and Process Control for Microlithography XII SPIE's 24th Annual International Symposium on Microlithography, SPIE February 1999. Proc. SPIE Int. Soc. Opt. Eng. 3677, 447 (1999)
166. Xinhui Niu, Nickhil Jakatdar , Costas J. Spanos, Bob Socha, Joe Bendik, “Deep-ultraviolet lithography simulator tuning by resist profile matching“, International Symposium on Microelectronic Manufacturing Technologies, 1999. Proc. SPIE Int. Soc. Opt. Eng. 3741, 245 (1999)
167. Nickhil Jakatdar , Junwei Bao, Costas J. Spanos, Ramkumar Subramanian, Bharath Rangarajan, Andy Romano, “Physically based model for predicting volume shrinkage in chemically amplified resists“, International Symposium on Microelectronic Manufacturing Technologies, 1999. Proc. SPIE Int. Soc. Opt. Eng. 3743, 16 (1999)
168. Mike Orshansky, Costas J. Spanos and Chenming Hu, “Circuit Performance Variability Decomposition”, Fourth International Statistical Metrology Workshop, Kyoto, Japan, June 1999.
169. Darin Fisher, Mason Freed, Costas J. Spanos and Kameshwar Poolla, “Microsensor Arrays for Calibration, Control and Monitoring of Semiconductor Manufacturing Processes”, IEEE

International Conference on Control Applications and Symposium on Computer-Aided Control System Design, Hawaii, August, 1999.

170. J. Bokor, N. Cheung, D. Dornfeld, D. Graves, E. Haller, M. Lieberman, A. Neureuther, K. Poolla, Costas J. Spanos, R. Smith, O. Solgaard, B. Dunn, E. Aydil, "The Small Feature Reproducibility Project", AEC/APC Symposium XI, Vail, Colorado, September, 1999.
171. Junwei Bao, Nickhil Jakatdar ,Costas J. Spanos, Joseph J. Bendik, Xinhui Niu, "Specular spectral profilometry on metal layers", Microlithography, SPIE, February, 2000 . Proc. SPIE Int. Soc. Opt. Eng. 3998, 882 (2000)
172. Nickhil H. Jakatdar, Xinhui Niu, Junwei Bao, Costas J. Spanos, Sanjay K. Yedur, and Alain G. Deleporte, "Phase profilometry for the 193-nm lithography gate stack", Proc. SPIE Int. Soc. Opt. Eng. 3998, 116 (2000)
173. Michiel V.P. Krüger, Michael H. Guddal, Ruslan Belikov, Aparna Bhatnagar, Olav Solgaard, Costas J. Spanos, and Kameshwar Poolla "Low Power Wireless Readout of Autonomous Sensor Wafer using MEMS Grating Light Modulator", Optical MEMs 2K, Hawaii, August 2000.
174. Jiangxin Wang and Costas J. Spanos, "A Sensor Fusion Based Methodology for Real Time Furnace Diagnostics", ASMC, September, 2000.
175. Mason Freed, Michiel Krüger, Kameshwar Poolla, and Costas J. Spanos, "Real Time In-Situ Data Acquisition Using Autonomous On-Wafer Sensor Arrays", ISSM, September, 2000.
176. N. Chong, J. Lim, J. Sakamoto, B. Dunn, M. Kruger, M. Freed, S. Eitapence, K. Poolla, and Costas J. Spanos,"Lithium Batteries For Powering Sensor Arrays", 198th meeting of the Electrochemical Society, Phoenix, Az, October, 2000
177. Jiangxin Wang and Costas J. Spanos, "A Novel approach for modeling and diagnostics", AEC/APC Symposium XII, Banf, Canada, October 2001.
178. Junwei Bao and Costas J. Spanos, "A Simulation framework for lithography process monitoring and control using scatterometry", AEC/APC Symposium XII, Banf, Canada, October 2001
179. Dong Wu Zhao and Costas J. Spanos, "Towards a Complete Plasma Diagnostic System", ICCM, Santa Clara, CA, October 2001.
180. Runzi Chang and Costas J. Spanos, "Full Profile Inter-Layer Dielectric (ILD) CMP Metrology", ICCM, Santa Clara, CA, October 2001.
181. Payman Jula, Costas J. Spanos, Robert C. Lieberman, "The Economic Impact of Choosing off-line, inline or insitu Metrology Deployment in Semiconductor Manufacturing", ICCM, Santa Clara, CA, October 2001.
182. Haolin Zhang, Jason Cain and Costas J. Spanos, "Compact formulation of mask error factor for critical dimension control in optical lithography", SPIE February 2002. Proc. SPIE Int. Soc. Opt. Eng. 4689, 462 (2002)
183. Jason P. Cain, Haolin Zhang, and Costas J. Spanos, "Optimum sampling for characterization of systematic variation in photolithography", SPIE February 2002. Proc. SPIE Int. Soc. Opt. Eng. 4689, 430 (2002)
184. David Steele, Anthony Coniglio, Cherry Tang, Bhanwar Singh, Costas J. Spanos, Steve Nip, "Characterizing post-exposure bake processing for transient- and steady-state conditions in the context of critical dimension control", SPIE February 2002. Proc. SPIE Int. Soc. Opt. Eng. 4689, 517 (2002)

185. Michiel Kruger, Kameshwar Poolla and Costas J. Spanos, "Electrical Impedance based tomography based Sensors for Semiconductor Manufacturing", 2002 American Control Conference, May 8-10, 2002, Anchorage, Alaska.
186. Runzi Chang, Yu Cao, and Costas J. Spanos, "Modeling Metal Dishing for Interconnect Optimization", CMP 2003
187. Paul D. Friedberg, Costas J. Spanos, "First Principle-based state estimator for Photolithography Control", AECAPC 2003
188. Jason P. Cain and Costas J. Spanos, "Electrical linewidth metrology for systematic CD variation characterization and causal analysis"Jason P. Cain and Costas J. Spanos Proc. SPIE Int. Soc. Opt. Eng. 5038, 350 (2003)
189. Runzi Chang, Yu Cao, and Costas J. Spanos, "Modeling Metal Dishing for Interconnect Optimization", IEDM 2003
190. Q. Zhang, P. Friedberg C. Tang, B. Singh K. Poolla, Costas J. Spanos, "Across-wafer CD uniformity enhancement through control of multi-zone PEB profiles", SPIE 2004. Proc. SPIE Int. Soc. Opt. Eng. 5375, 276 (2004)
191. H. Hung, J. H. Chen, Costas J. Spanos, S. Wang, "Quantification of transient post exposure bake behavior and its impact on 193-nm lithography", Poster, SPIE 2004
192. Paul D. Friedberg, Cherry Tang, Bhanwar Singh, Thomas Brueckner, Wolfram Gruendke, Bernd Schulz, and Costas J. Spanos, "Time-based PEB adjustment for optimizing CD distributions", Proc. SPIE Int. Soc. Opt. Eng. 5375, 703 (2004)
193. Kruger, M.V.P.; Poolla, K.; Spanos, C.J, "A class of impedance tomography based sensors for semiconductor manufacturing", American Control Conference, 2004. Proceedings of the 2004, Volume 3, 30 June-2 July 2004 Page(s):2178 - 2183 vol.3
194. Jing Xue and Costas J. Spanos, "Design of an integrated aerial image sensor", Proc. SPIE Int. Soc. Opt. Eng. 5752, 392 (2005)
195. Qiaolin Zhang, Kameshwar Poolla, and Costas J. Spanos, "Modeling of mask thermal distortion and its dependency on pattern density"Proc. SPIE Int. Soc. Opt. Eng. 5853, 234 (Photo Mask Japan) (2005)
196. Qiaolin Zhang, Cherry Tang, Tony Hsieh, Nick Maccrae, Bhanwar Singh, Kameshwar Poolla and Costas J. Spanos, "Comprehensive CD uniformity control across lithography and etch", Proc. SPIE Int. Soc. Opt. Eng. 5752, 692 (2005)
197. Jason P. Cain, Patrick Naulleau, and Costas J. Spanos, "Resist-based measurement of the contrast transfer function in a 0.3-NA EUV microfield optic", Proc. SPIE Int. Soc. Opt. Eng. 5751, 741 (2005)
198. Jason P. Cain, Patrick Naulleau, and Costas J. Spanos, "Lithographic measurement of EUV flare in the 0.3-NA micro exposure tool optic at the Advanced Laser Source", Proc. SPIE Int. Soc. Opt. Eng. 5751, 301 (2005)
199. Jason P. Cain, Gregory McIntyre, Patrick Naulleau, Adam Pawloski, Bruno La Fontaine, Obert Wood II, Costas J. Spanos, and Andrew R. Neureuther , "Two-wave pattern shift aberration monitor for centrally obscured optical systems", Proc. SPIE Int. Soc. Opt. Eng. 5751, 1230 (2005)
200. Jason P. Cain, Patrick Naulleau, and Costas J. Spanos, "Modeling of EUV photoresists with a resist point spread function", Proc. SPIE Int. Soc. Opt. Eng. 5751, 1101 (2005)
201. Jason P. Cain, Patrick Naulleau, and Costas J. Spanos, "Critical dimension sensitivity to post-exposure bake temperature variations in EUV photoresists", Proc. SPIE Int. Soc. Opt. Eng. 5751, 1092 (2005)

202. Paul Friedberg, Yu Cao, Jason Cain, Ruth Wang, Jan Rabaey, and Costas J. Spanos, "Modeling Within-Die Spatial Correlation Effects for Process-Design Co-Optimization", ISQED March 2005
203. Qiaolin(Charlie) Zhang, Paul Friedberg, Kameshwar Poolla, Costas J. Spanos, "Enhanced Spatial PEB Uniformity Through A Novel Bake Plate Design", AEC-APC XVII, 9/26-28, 2005 (Best Student Paper Award)
204. Jing Xue, Kurt Moen, and Costas J. Spanos, "Integrated Aerial Image Sensor (IAIS): Concept, Design and Modeling", AEC-APC XVII 9/26-28, 2005
205. P. Friedberg, W. Cheung, and Costas J. Spanos, "Spatial Modeling of Micron-Scale Gate Length Variation"27-Feb-2006; Data Analysis and Modeling for Patterning Control III, SPIE vol. 6155, (Pub P014892).
206. Q. Zhang, K. Poolla, Costas J. Spanos, "Across Wafer Post Etch CD Uniformity Enhancement through Model Based Control", AEC/APC XVIII 2006. (Best Student Paper Award)
207. Jing Xue, Kurt Moen, and Costas J. Spanos, "Integrated Aerial Image Sensor: Modeling and Assembly", Proc. of SPIE, Vol. 6152, pp.615221, 2006
208. Jing Xue, Kurt Moen, and Costas J. Spanos, "Integrated Aerial Image Sensor: Design, Modeling and Assembly", 50th EIPBN 5/30-6/2, 2006
209. Qian Ying Tang, Paul Friedberg, George Cheng, and Costas J. Spanos, "Circuit size optimization with multiple sources of variation and position dependent correlation", Proc. of SPIE, Vol. 6521, 65210P (2007), San Jose, CA.
210. Paul Friedberg, Willy Cheung, George Cheng, Qian Ying Tang, and Costas J. Spanos, "Modeling spatial gate length variation in the 0.2µm to 1.15mm separation range,"Proc. SPIE Vol. 6521, 652119 (2007), San Jose, CA.
211. Andy Neureuther, Wojtek Poppe, Juliet Holwill, Eric Chin, Lynn Wang, Jae-Seok Yang, Marshal Miller, Dan Ceperley, Chris Clifford, Koji Kikuchi, Jihong Choi, Dave Dornfeld, Paul Friedberg, and Costas J. Spanos, Jerry Hsu, David Graves, Alan C. F. Wu, and Mike Lieberman John Hoang and Jane Chang, "Collaborative platform, tool-kit, and physical models for DfM"Proc. SPIE Vol. 6521, 652104 (2007), San Jose, CA.
212. Qiaolin Zhang, Cherry Tang, Jason Cain, Angela Hui, Tony Hsieh, Nick Maccrae, Bhanwar Singh, Kameshwar Poolla, and Costas J. Spanos, "Across-wafer CD uniformity control through lithography and etch process: experimental verification", Proc. SPIE 6518, 65182C (2007), San Jose, CA.
213. Jing Xue, Yu Ben, Marshal A. Miller, Costas J. Spanos, Andrew R. Neureuther, "Parameter sensitive PSM patterns for scatterometry monitoring"(Poster Presentation) Paper 6730-174 of Conference 6730, BACUS 2007.
214. Dekong Zeng, Yajing Tan, Costas J. Spanos, "Dimensionality reduction methods in virtual metrology (Conference Proceedings Paper) Proc. SPIE Vol: 6922, (2008), San Jose, CA.
215. Jing Xue, Costas J. Spanos, and Andrew R. Neureuther, "Probe-pattern grating focus monitor through scatterometry calibration", Proc. SPIE 6922, 692225 (2008)
216. Kedar Patel, Tsu-Jae King Liu, and Costas J. Spanos, "Impact of gate line edge roughness on double-gate FinFET performance variability", Proc. SPIE 6925, 69251I (2008)
217. Kun Qian and Costas J. Spanos, "A comprehensive model of process variability for statistical timing optimization", Proc. SPIE 6925, 69251G (2008)
218. Yu Ben, Jing Xue, and Costas J. Spanos, "Using composite gratings for optical system characterization through scatterometry", Proc. SPIE 6925, 69251B (2008)

219. Qian Ying Tang and Costas J. Spanos, “Layout optimization based on a generalized process variability model”, Proc. SPIE 6925, 69250F (2008)
220. Ning Ma, Justin Ghan, Sandipan Mishra, Costas J. Spanos, Kameshwar Poolla, Norma Rodriguez, and Luigi Capodieci, “Automatic hotspot classification using pattern-based clustering”, Proc. SPIE 6925, 692505 (2008)
221. Jing Xue, Costas J. Spanos, Andrew R. Neureuther, “Printing Assessment and scatterometry calibration of Probe Pattern Grating Focus monitor”, AEC/APC October 2008, Salt Lake City, UT (Best Student Paper Award)
222. DeKong Zeng, Costas J. Spanos, Yajing Tan, Tzu-yu Wang, Chen-hsien Lin, Henry Lo, Jean Wang, C.H. Yu, „Virtual Metrology Modeling for Plasma Etch Operations”, ISSM October 2008, Tokyo.
223. Justin Ghan, Ning Ma, Sandipan Mishra, Costas J. Spanos, Kameshwar Poolla, Norma Rodriguez, and Luigi Capodieci, “Clustering and pattern matching for an automatic hotspot classification and detection system”, Proc. SPIE 7275, 727516 (2009)
224. Qian Ying Tang and Costas J. Spanos, “Interval-value based circuit simulation for statistical circuit design”, Proc. SPIE 7275, 72750J (2009)
225. Kun Qian, Borivoje Nikolić, and Costas J. Spanos, “Hierarchical modeling of spatial variability with a 45nm example”, Proc. SPIE 7275, 727505 (2009)
226. Kun Qian and Costas J. Spanos, “Hierarchical Modeling of Spatial Variability of a 45nm Test Chip and beyond”, SPIE 2009
227. L. Cheng, P. Gupta, Costas J. Spanos, K. Qian, and L. He , “Physically Justifiable Die-Level Modeling of Spatial Variation in View of Systematic Across Wafer Variability,”Design Automation Conference (DAC), July 2009, pp: 104-109.
228. Kun Qian and Costas J. Spanos, “45nm transistor variability study for memory characterization”, Proc. SPIE 7641, 76410G (2010)
229. Kedar Patel, Thomas Wallow, Harry J. Levinson, and Costas J. Spanos, “Comparative study of line width roughness (LWR) in next-generation lithography (NGL) processes”, Proc. SPIE 7640, 76400T (2010)
230. Yu Ben; El Ghaoui, L.; Poolla, K.; Spanos, C.J.; , “Yield-constrained digital circuit sizing via sequential geometric programming,”Quality Electronic Design (ISQED), 2010 11th International Symposium on , vol., no., pp.114-121, 22-24 March 2010
231. Kedar Patel, Soumendra N. Lahiri, Costas J. Spanos, “Robust and Accurate Estimation of Line Width Roughness (LWR) Parameters”, EIPBN, Anchorage, Alaska, June 1-4 2010.
232. Qian Ying Tang, Costas J. Spanos, “Non-Gaussian Uncertainty Propagation in Statistical Transient Circuit Simulation”, IEEE International Workshop on Design for Manufacturability and Yield, San Diego, CA, June 10, 2010
233. Kun Qian and Costas J. Spanos, “Physical / Statistical Extraction of Compact Transistor Model Parameters”, IEEE International Workshop on Design for Manufacturability and Yield, San Diego, CA, June 10, 2010
234. Andrew R. Neureuther, Juliet Rubinstein, Marshal Miller, Kenji Yamazoe, Eric Chin, Cooper Levy, Lynn Wang, Nuo Xu, Costas J. Spanos, Kun Qian, Kameshwar Poolla, Justin Ghan, Anand Subramanian, Tsu-Jae King Liu, Xin Sun, Kwangok Jeong, Puneet Gupta, Abde Kaqalwalla, Rani Ghaida, and Tuck Boon Chan, “Collaborative research on emerging technologies and design”, Proc. SPIE 8081, 80810N (2011)
235. Yu Ben and Costas J. Spanos, “Partial least squares-preconditioned importance sampling for fast circuit yield estimation”, Proc. SPIE 7974, 79740P (2011)

236. Tang, Qian Ying; Spanos, Costas; , "Non-Gaussian uncertainty propagation in statistical circuit simulation,"12th International Symposium on Quality Electronic Design (ISQED), 201 , vol., no., pp.1-8, 14-16 March 2011
237. Ben, Yu; Spanos, Costas J.; , "Estimating the probability density function of critical path delay via partial least squares dimension reduction,"12th International Symposium on Quality Electronic Design (ISQED), 2011, vol., no., pp.1-7, 14-16 March 2011
238. Ying Qiao and Costas J. Spanos, "Linear Propagation Methodology in Compact Variability Modeling", IEEE International Workshop on Design for Manufacturability and Yield, San Diego, CA, June 6, 2011
239. Statistical Compact Model Characterization for Variability-Aware IC Optimization Kun Qian, Ying Qiao, Prof. Costas J. Spanos, UC Berkeley, Workshop on Variability Modeling and Characterization (VMC), International Conference on Computer-Aided Design, Santa Clara, CA, November 11th, 2011.
240. Ying Qiao, Kun Qian and Costas J. Spanos, "Variability-Aware Compact Model Characterization for Statistical Circuit Design Optimization", Proc. SPIE (2012)
241. Jae Yeon (Claire) Baek and Costas J. Spanos, "Optimization of Blended Virtual and Actual Metrology Schemes", Proc. SPIE (2012)
242. Jae Yeon Baek and Costas J. Spanos Effect of Periodic Virtual Metrology Recalibration on the Performance of Blended (Actual/Virtual) Metrology Schemes, Advanced Process Control Conference, 2012
243. Costas J. Spanos and Jae Yeon Baek, "Enhancing Metrology by Combining Spatial Variability and Global Inference", Proc. SPIE (2013)
244. Weekly, K.; Donghyun Rim; Lin Zhang; Bayen, A.M.; Nazaroff, W.W.; Spanos, C.J., "Low-cost coarse airborne particulate matter sensing for indoor occupancy detection,"*Automation Science and Engineering (CASE), 2013 IEEE International Conference on* , vol., no., pp.32,37, 17-20 Aug. 2013 - Best Application Paper Award
245. Kai Ma; Guoqiang Hu; Spanos, C.J., "Energy consumption scheduling in smart grid: A non-cooperative game approach,"*Control Conference (ASCC), 2013 9th Asian*, vol., no., pp.1,6, 23-26 June 2013
246. Bin Li; Wei Feng; Lin Zhang; Spanos, C., "DEPEND: Density adaptive power efficient neighbor discovery for wearable body sensors,"*Automation Science and Engineering (CASE), 2013 IEEE International Conference on* , vol., no., pp.581,586, 17-20 Aug. 2013
247. Kai Ma; Guoqiang Hu; Spanos, C.J., "Transmission power allocation for cooperative relay-based neighborhood area networks for smart grid,"*Automation Science and Engineering (CASE), 2013 IEEE International Conference on* , vol., no., pp.599,604, 17-20 Aug. 2013
248. Yuxun Zhou; Zhaoyi Kang; Lin Zhang; Spanos, C., "Causal analysis for non-stationary time series in sensor-rich smart buildings,"*Automation Science and Engineering (CASE), 2013 IEEE International Conference on* , vol., no., pp.593,598, 17-20 Aug. 2013
249. Zhaoyi Kang; Yuxun Zhou; Lin Zhang; Spanos, C.J., "Virtual power sensing based on a multiple-hypothesis sequential test,"*Smart Grid Communications (SmartGridComm), 2013 IEEE International Conference on* , vol., no., pp.785,790, 21-24 Oct. 2013
250. Kai Ma; Guoqiang Hu; Spanos, C.J., "Dynamics of electricity markets with unknown utility functions: An extremum seeking control approach,"*Control & Automation (ICCA), 11th IEEE International Conference on*, vol., no., pp.302,307, 18-20 June 2014
251. Ratliff, L.J.; Ming Jin; Konstantakopoulos, I.C.; Spanos, C.; Sastry, S.S., "Social game for building energy efficiency: Incentive design,"*Communication, Control, and Computing*

(Allerton), 2014 52nd Annual Allerton Conference on , vol., no., pp.1011,1018, Sept. 30 2014-Oct. 3 2014

252. Ming Jin; Han Zou; Weekly, K.; Ruoxi Jia; Bayen, A.M.; Spanos, C.J., "Environmental sensing by wearable device for indoor activity and location estimation,"*Industrial Electronics Society, IECON 2014 - 40th Annual Conference of the IEEE* , vol., no., pp.5369,5375, Oct. 29 2014-Nov. 1 2014
253. Zhaoyi Kang; Ming Jin; Spanos, C.J., "Modeling of end-use energy profile: An appliance-data-driven stochastic approach,"*Industrial Electronics Society, IECON 2014 - 40th Annual Conference of the IEEE* , vol., no., pp.5382,5388, Oct. 29 2014-Nov. 1 2014
254. Zhaoyi Kang; Spanos, C.J., "Sequential Logistic Principal Component Analysis (SLPCA): Dimensional Reduction in Streaming Multivariate Binary-State System,"*Machine Learning and Applications (ICMLA), 2014 13th International Conference on* , vol., no., pp.171,177, 3-6 Dec. 2014
255. Kai Ma; Guoqiang Hu; Spanos, C.J., "Cooperative demand response using repeated game for price-anticipating buildings in smart grid,"*Control Automation Robotics & Vision (ICARCV), 2014 13th International Conference on* , vol., no., pp.565,570, 10-12 Dec. 2014
256. Jin, M., R. Jia, Z. Kang, I. C. Konstantakopoulos, and C. Spanos, "PresenceSense: Zero-training Algorithm for Individual Presence Detection based on Power Monitoring."In: BuildSys14, November 5–6, 2014, Memphis, TN, USA, 2014.
257. Poon, J.; Konstantakopoulos, I.C.; Spanos, C.; Sanders, S.R., "Real-time model-based fault diagnosis for switching power converters,"*Applied Power Electronics Conference and Exposition (APEC), 2015 IEEE* , vol., no., pp.358,364, 15-19 March 2015
258. Yuxun Zhou, Costas J. Spanos. "Learning Convex Piecewise Linear Machine for Data-driving Optimal Control". IEEE International Conference on Machine Learning and Applications (ICMLA) 2015
259. Ming Jin, Lin Zhang, Costas Spanos, "Power Prediction through Energy Consumption Pattern Recognition for Smart Buildings", IEEE International Conference on Automation Science and Engineering (IEEE CASE 2015); 08/2015
260. Ming Jin, Ruoxi Jia, Costas Spanos, "APEC: Auto Planner for Efficient Configuration of Indoor Positioning Systems", The 9th International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies (UBICOMM'15); 07/2015
261. Ming Jin, Nikolaos Bekiaris-Liberis, Kevin Weekly, Costas Spanos, Alexandre Bayen "Sensing by Proxy: Occupancy Detection Based on Indoor CO_2 Concentration", The 9th International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies (UBICOMM'15); 07/2015 – Best Paper Award
262. Ruoxi Jia, Yang Gao, Costas Spanos. "A Fully Unsupervised Non-intrusive Load Monitoring Framework."IEEE SmartGridComm 2015.
263. Yuxun Zhou, Reza Arghandeh, Ioannis Konstantakopoulos, Shayaan Abdullah, Alexandra von Meier, Costas J. Spanos. "Learning Based Event Detection with High Resolution micor-PMU Measurement". 19th Power Systems Computation Conference (PSCC), *abstract accepted*
264. Jin, M., L. Zhang, and C. Spanos (2015). "Power Prediction through Energy Consumption Pattern Recognition for Smart Buildings". *CASE 2015*.
265. Ruoxi Jia, Ming Jin, Zilong Chen, Costas Spanos, "SoundLoc: Accurate Room-level Indoor Localization using Acoustic Signatures."*CASE 2015*.
266. Jin, M. and C. Spanos (2015). "BRIEF: Bayesian Regression of Infinite Expert Forecasters for Single and Multiple Time Series Prediction."In: *accepted to CDC2015*.

267. Jin, M., L. J. Ratliff, I. C. Konstantakopoulos, C. Spanos, and S. Sastry, "REST: A Reliable Estimation and Stopping Time Algorithm for Social Game Experiments."In: *ACM/IEEE 6th International Conference on Cyber-Physical Systems (ICCPS), 2015.*
268. IC Konstantakopoulos, LJ Ratliff, M Jin, SS Sastry, C Spanos, "Social game for building energy efficiency: Utility learning, simulation, and analysis," *arXiv preprint arXiv:1407.0727*
269. Zhenghua Chen, Qingchang Zhu, Hao Jiang, Han Zou, Yeng Chai Soh, Lihua Xie, Ruoxi Jia, Costas Spanos. An iBeacon Assisted Indoor Localization and Tracking System. IPSN 2015.
270. Ming Jin, Lillian J. Ratliff, Ioannis C. Konstantakopoulos, Costas Spanos, S. Shankar Sastry. "REST: A Reliable Estimation and Stopping Time Algorithm for, Social Game Experiments."*ICCPS, 2015.*
271. Jason Poon, Ioannis C. Konstantakopoulos, Costas Spanos, Seth R. Sanders. "Real-Time Model-Based Fault Diagnosis for Switching Power Converters"*APEC, 2015*
272. Jason Poon, Ioannis C. Konstantakopoulos, Reza Arghandeh, Palak Jain, Jaime, F. Fisac, S. Shankar Sastry, Sanjib Kumar Panda, Costas Spanos, Seth R. Sanders. "FailSafe: A Generalized Methodology for Converter Fault Detection, Identification, and Remediation in Nanogrids"*ICBEST, 2015*
273. Jin, Ming; Zhang, Lin; Spanos, Costas J; "Power prediction through energy consumption pattern recognition for smart buildings", Automation Science and Engineering (CASE), 2015 IEEE International Conference on"419-424 2015
274. Jia, Ruoxi; Jin, Ming; Chen, Zilong; Spanos, Costas J; "SoundLoc: Accurate room-level indoor localization using acoustic signatures", Automation Science and Engineering (CASE), 2015 IEEE International Conference on"186-193 2015
275. Jia, Ruoxi; Jin, Ming; Zou, Han; Yesilata, Yigitcan; Xie, Lihua; Spanos, Costas; "MapSentinel: Map-Aided Non-intrusive Indoor Tracking in Sensor-Rich Environments Proceedings of the 2nd ACM International Conference on Embedded Systems for Energy-Efficient Built Environments 109-110 2015 ACM
276. Jin, Ming; Jia, Ruoxi; Spanos, C; "APEC: Auto Planner for Efficient Configuration of Indoor Positioning System "The 9th International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies (UBICOMM)" 2015
277. Jin, Ming; Spanos, Costas J; "Brief: Bayesian regression of infinite expert forecasters for single and multiple time series prediction "Decision and Control (CDC), 2015 IEEE 54th Annual Conference on, 78-83 2015
278. Jia, Ruoxi; Gao, Yang; Spanos, Costas J; "A fully unsupervised non-intrusive load monitoring framework "Smart Grid Communications (SmartGridComm), 2015 IEEE International Conference on" 872-878 2015
279. Jin, Ming; Spanos, Costas; "Inverse Reinforcement Learning via Deep Gaussian Process", arXiv preprint arXiv:1512.08065 2015
280. Zhou, Yuxun; Li, Dan; Spanos, Costas J; "Learning optimization friendly comfort model for hvac model predictive control "Data Mining Workshop (ICDMW), 2015 IEEE International Conference on, 430-439 2015
281. Qiao, Ying; Spanos, Costas J; "Variability-aware compact modeling and statistical circuit validation on SRAM test array", SPIE Advanced Lithography, 97810D-97810D-9 2016, International Society for Optics and Photonics
282. Konstantakopoulos, Ioannis C; Ratliff, Lillian J; Jin, Ming; Spanos, Costas J; Sastry, S Shankar; "Inverse modeling of non-cooperative agents via mixture of utilities", Decision and Control (CDC), 2016 IEEE 55th Conference on" 6327-6334 2016

283. Konstantakopoulos, Ioannis C; Ratliff, Lillian J; Jin, Ming; Spanos, Costas; Sastry, S Shankar; “Smart building energy efficiency via social game: A robust utility learning framework for closingÉ__theÉ__loop “Science of Smart City Operations and Platforms Engineering (SCOPE) in partnership with Global City Teams Challenge (GCTC)(SCOPE-GCTC), 2016 1st International Workshop on” 6-Jan 2016
284. Jia, Ruoxi; Jin, Ming; Zou, Han; Yesilata, Yigitcan; Xie, Lihua; Spanos, Costas; “MapSentinel: Can the Knowledge of Space Use Improve Indoor Tracking Further? Sensors 16 4 472 2016 Multidisciplinary Digital Publishing Institute
285. Poon, Jason; Jain, Palak; Konstantakopoulos, Ioannis C; Spanos, Costas; Panda, Sanjib Kumar; Sanders, Seth R; “Model-based fault detection and identification for switching power converters IEEE Transactions on Power Electronics 32 2 1419-1430 2017
286. Zhou, Yuxun; Jin, Baihong; Spanos, Costas J; “Learning convex piecewise linear machine for data-driven optimal control“, Machine Learning and Applications (ICMLA), 2015 IEEE 14th International Conference on” 966-972 2015
287. Zhou, Yuxun; Baek, Jae Yeon; Li, Dan; Spanos, Costas J; “Optimal training and efficient model selection for parameterized large margin learning Pacific-Asia Conference on Knowledge Discovery and Data Mining 52-64 2016 Springer International Publishing
288. Zhou, Yuxun; Hu, Ninghang; Spanos, Costas J; “Veto-Consensus Multiple Kernel Learning. AAAI 2407-2414 2016
289. Jia, Ruoxi; Dong, Roy; Sastry, S Shankar; Spanos, Costas J; “Privacy-enhanced architecture for occupancy-based HVAC control Proceedings of the 8th International Conference on Cyber-Physical Systems 177-186 2017 ACM
290. Zhou, Yuxun; Arghandeh, Reza; Konstantakopoulos, Ioannis; Abdullah, Shayaan; von Meier, Alexandra; Spanos, Costas J; “Abnormal event detection with high resolution micro-PMU data “Power Systems Computation Conference (PSCC), 2016” 7-Jan 2016
291. Zhou, Yuxun; Arghandeh, Reza; Konstantakopoulos, Ioannis; Abdullah, Shayaan; Spanos, Costas J; “Data-driven event detection with partial knowledge: A hidden structure semi-supervised learning method “American Control Conference (ACC), 2016” 5962-5968 2016
292. Leahy, Kevin; Hu, R Lily; Konstantakopoulos, Ioannis C; Spanos, Costas J; Agogino, Alice M; “Diagnosing wind turbine faults using machine learning techniques applied to operational data “Prognostics and Health Management (ICPHM), 2016 IEEE International Conference on” 8-Jan 2016
293. Zou, Han; Jin, Ming; Jiang, Hao; Xie, Lihua; Spanos, Costas; “WinIPS: WiFi-based non-intrusive IPS for online radio map construction”, Computer Communications Workshops (INFOCOM WKSHPS), 2016 IEEE Conference on, 1081-1082 2016
294. Gu, Weixi; Jin, Ming; Zhou, Zimu; Spanos, Costas J; Zhang, Lin; “MetroEye: towards fine-grained passenger tracking underground”, Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct 77-80 2016 ACM
295. Jain, Palak; Xu, Jian-Xin; Panda, Sanjib Kumar; Poon, Jason; Spanos, Costas; Sanders, Seth R; “Fault diagnosis via PV panel-integrated power electronics”, Control and Modeling for Power Electronics (COMPEL), 2016 IEEE 17th Workshop on” 6-Jan 2016
296. Zou, Han; Zhou, Yuxun; Jiang, Hao; Huang, Baoqi; Xie, Lihua; Spanos, Costas; “A transfer kernel learning based strategy for adaptive localization in dynamic indoor environments”, poster Proceedings of the 22nd Annual International Conference on Mobile Computing and Networking 462-464 2016 ACM

297. Konstantakopoulos, Ioannis C; Ratliff, Lillian J; Jin, Ming; Sastry, S Shankar; Spanos, Costas J; "Robust Utility Learning with Applications to Social Games in Smart Buildings"
298. Zhou, Yuxun; Spanos, Costas J; "Causal meets submodular: Subset selection with directed information Advances in Neural Information Processing Systems 2649-2657 2016
299. Jin, Ming; Bekiaris-Liberis, Nikolaos; Weekly, Kevin; Spanos, Costas J; Bayen, Alexandre M; "Occupancy detection via environmental sensing", IEEE Transactions on Automation Science and Engineering 2016
300. Li, Dan; Zhou, Yuxun; Hu, Guoqiang; Spanos, Costas J; "Fusing system configuration information for building cooling plant Fault Detection and severity level identification", Automation Science and Engineering (CASE), 2016 IEEE International Conference on" 1319-1325 2016
301. Zhou, Yuxun; Arghandeh, Reza; Konstantakopoulos, Ioannis C; Abdullah, Shayaan; von Meier, Alexandra; Spanos, Costas J; "Distribution Network Event Detection with Ensembles of Bundle Classifiers", IEEE PES General Meeting 2016
302. Gu, Weixi; Jin, Ming; Zhou, Zimu; Spanos, Costas J; Zhang, Lin; "MetroEye: Smart Tracking Your Metro Trips Underground", MobiQuitous 84-93 2016
303. Jia, Ruoxi; Spanos, Costas; "Occupancy modelling in shared spaces of buildings: a queueing approach Journal of Building Performance Simulation", 10 4 406-421 2017 Taylor & Francis
304. Zhou, Yuxun; Arghandeh, Reza; Spanos, Costas J; "Online learning of Contextual Hidden Markov Models for temporal-spatial data analysis", Decision and Control (CDC), 2016 IEEE 55th Conference on" 6335-6341 2016
305. Zhou, Yuxun; Spanos, Costas J; "On a class of multi-parametric quadratic programming and its applications to machine learning", Decision and Control (CDC), 2016 IEEE 55th Conference on" 2826-2833 2016
306. Li, Dan; Zhou, Yuxun; Hu, Guoqiang; Spanos, Costas J; "Optimal Sensor Configuration and Feature Selection for AHU Fault Detection and Diagnosis", IEEE Transactions on Industrial Informatics 13 3 1369-1380 2017
307. Hu, R Lily; Leahy, Kevin; Konstantakopoulos, Ioannis C; Auslander, David M; Spanos, Costas J; Agogino, Alice M; "Using Domain Knowledge Features for Wind Turbine Diagnostics", Machine Learning and Applications (ICMLA), 2016 15th IEEE International Conference on 300-307 2016
308. Feng, Wei; Szu-Cheng, Chien; Shwe, Hnin Yu; Jet, Tseng King; Spanos, Costas J; Panda, Sanjib Kumar; "Condition monitoring system of Ubin Island micro-grid", Power Electronics Conference (SPEC), IEEE Annual Southern 6-Jan 2016
309. Zhou, Yuxun; Kang, Zhaoyi; Spanos, Costas J; "Parametric Dual Maximization for Non-Convex Learning Problems. AAAI 2956-2962 2017
310. Zou, Han; Zhou, Yuxun; Jiang, Hao; Huang, Baoqi; Xie, Lihua; Spanos, Costas; "Adaptive Localization in Dynamic Indoor Environments by Transfer Kernel Learning", Wireless Communications and Networking Conference (WCNC), 2017 IEEE" 6-Jan 2017
311. Poon, Jason; Jain, Palak; Konstantakopoulos, Ioannis C; Spanos, Costas; Panda, Sanjib Kumar; Sanders, Seth R; Model-based fault detection and identification for switching power converters IEEE Transactions on Power Electronics 32 2 1419-1430 2017 IEEE
312. Jia, Ruoxi; Dong, Roy; Sastry, S Shankar; Sapnos, Costas J; Privacy-enhanced architecture for occupancy-based HVAC control Cyber-Physical Systems (ICCPS), 2017 ACM/IEEE 8th International Conference on 177-186 2017 IEEE

313. Jia, Ruoxi; Spanos, Costas; Occupancy modelling in shared spaces of buildings: a queueing approach Journal of Building Performance Simulation 10 4 406-421 2017 Taylor & Francis
314. Li, Dan; Zhou, Yuxun; Hu, Guoqiang; Spanos, Costas J; Optimal sensor configuration and feature selection for ahu fault detection and diagnosis IEEE Transactions on Industrial Informatics 13 3 1369-1380 2017 IEEE
315. Poon, Jason; Jain, Palak; Spanos, Costas; Panda, Sanjib Kumar; Sanders, Seth R; Fault prognosis for power electronics systems using adaptive parameter identification IEEE Transactions on Industry Applications 53 3 2862-2870 2017 IEEE
316. Jin, Ming; Jia, Ruoxi; Spanos, Costas J; Virtual occupancy sensing: Using smart meters to indicate your presence IEEE Transactions on Mobile Computing 16 11 3264-3277 2017 IEEE
317. Zhou, Yuxun; Kang, Zhaoyi; Spanos, Costas J; Parametric Dual Maximization for Non-Convex Learning Problems. AAAI 2956-2962 2017
318. Zou, Han; Zhou, Yuxun; Jiang, Hao; Huang, Baoqi; Xie, Lihua; Spanos, Costas; Adaptive localization in dynamic indoor environments by transfer kernel learning Wireless Communications and Networking Conference (WCNC), 2017 IEEE 1-6 2017 IEEE
319. Zou, Han; Chen, Zhenghua; Jiang, Hao; Xie, Lihua; Spanos, Costas; Accurate indoor localization and tracking using mobile phone inertial sensors, WiFi and iBeacon Inertial Sensors and Systems (INERTIAL), 2017 IEEE International Symposium on 1-4 2017 IEEE
320. Gu, Weixi; Zhang, Kai; Zhou, Zimu; Jin, Ming; Zhou, Yuxun; Liu, Xi; Spanos, Costas J; Shen, Zuo-Jun Max; Lin, Wei-Hua; Zhang, Lin; Measuring fine-grained metro interchange time via smartphones Transportation research part C: emerging technologies 81 153-171 2017 Pergamon
321. Poon, Jason; Jain, Palak; Spanos, Costas; Panda, Sanjib Kumar; Sanders, Seth R; Photovoltaic condition monitoring using real-time adaptive parameter identification Energy Conversion Congress and Exposition (ECCE), 2017 IEEE 1119-1124 2017 IEEE
322. Konstantakopoulos, Ioannis C; Ratliff, Lillian J; Jin, Ming; Spanos, Costas J; Leveraging correlations in utility learning American Control Conference (ACC), 2017 5249-5256 2017 IEEE
323. Nguyen, LV; Hu, Guoqiang; Spanos, Costas J; Efficient spatio-temporal sensor deployments: A smart building application Control & Automation (ICCA), 2017 13th IEEE International Conference on 2017 IEEE
324. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Gu, Weixi; Xie, Lihua; Spanos, Costas; Freedetector: Device-free occupancy detection with commodity wifi Sensing, Communication and Networking (SECON Workshops), 2017 IEEE International Conference on 1-5 2017 IEEE
325. Gu, Weixi; Liu, Yunxin; Zhou, Yuxun; Zhou, Zimu; Spanos, Costas J; Zhang, Lin; BikeSafe: bicycle behavior monitoring via smartphones Proceedings of the 2017 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 ACM International Symposium on Wearable Computers 45-48 2017 ACM
326. Gu, Weixi; Zhou, Yuxun; Zhou, Zimu; Liu, Xi; Zou, Han; Zhang, Pei; Spanos, Costas J; Zhang, Lin; Sugarmate: Non-intrusive blood glucose monitoring with smartphones Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies 1 3 54 2017 ACM
327. Nguyen, Linh; Hu, Guoqiang; Spanos, Costas J; Spatio-temporal environmental monitoring for smart buildings Control & Automation (ICCA), 2017 13th IEEE International Conference on 277-282 2017 IEEE

328. Jia, Ruoxi; Sangogboye, Fisayo Caleb; Hong, Tianzhen; Spanos, Costas; Kjærgaard, Mikkel Baun; Privacy-preserving building-related data publication using PAD Proceedings of the 4th ACM International Conference on Systems for Energy-Efficient Built Environments 32 2017 ACM
329. Jia, Ruoxi; Sangogboye, Fisayo Caleb; Hong, Tianzhen; Spanos, Costas; Kjærgaard, Mikkel Baun; Pad: Protecting anonymity in publishing building related datasets Proceedings of the 4th ACM International Conference on Systems for Energy-Efficient Built Environments 4 2017 ACM
330. Gu, Weixi; Zhou, Zimu; Zhou, Yuxun; Zou, Han; Liu, Yunxin; Spanos, Costas J; Zhang, Lin; BikeMate: Bike Riding Behavior Monitoring with Smartphones Proceedings of the 14th EAI International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services, MobiQuitous 2017 2017 ACM
331. Jain, Palak; Jian, Li; Poon, Jason; Spanos, Costas; Sanders, Seth R; Xu, Jian-Xin; Panda, Sanjib Kumar; A luenberger observer-based fault detection and identification scheme for photovoltaic DC-DC converters Industrial Electronics Society, IECON 2017-43rd Annual Conference of the IEEE 5015-5020 2017 IEEE
332. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Gu, Weixi; Xie, Lihua; Spanos, Costas; Poster: WiFi-based Device-Free Human Activity Recognition via Automatic Representation Learning Proceedings of the 23rd Annual International Conference on Mobile Computing and Networking 606-608 2017 ACM
333. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Gu, Weixi; Xie, Lihua; Spanos, Costas; Multiple Kernel Representation Learning for WiFi-Based Human Activity Recognition Machine Learning and Applications (ICMLA), 2017 16th IEEE International Conference on 268-274 2017 IEEE
334. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Gu, Weixi; Xie, Lihua; Spanos, Costas; Freecount: Device-free crowd counting with commodity wifi GLOBECOM 2017-2017 IEEE Global Communications Conference 1-6 2017 IEEE
335. Wang, Zheming; Hu, Guoqiang; Spanos, Costas J; Distributed model predictive control of bilinear HVAC systems using a convexification method Control Conference (ASCC), 2017 11th Asian 1608-1613 2017 IEEE
336. Jia, Ruoxi; Dong, Roy; Sastry, Shankar; Spanos, Costas; Optimal sensor-controller codesign for privacy in dynamical systems Decision and Control (CDC), 2017 IEEE 56th Annual Conference on 4004-4011 2017 IEEE
337. Sun, Jianxiao; Hu, Guoqiang; Spanos, Costas J; Development and verification of a multizone building HVAC model with TRNSYS Industrial Electronics and Applications (ICIEA), 2017 12th IEEE Conference on 887-894 2017 IEEE
338. Jia, Ruoxi; Dong, Roy; Ganesh, Prashanth; Sastry, Shankar; Spanos, Costas; Towards a theory of free-lunch privacy in cyber-physical systems Communication, Control, and Computing (Allerton), 2017 55th Annual Allerton Conference on 902-910 2017 IEEE
339. Xu, Zhanbo; Hu, Guoqiang; Spanos, Costas J; Reliability of high renewable penetration microgrid facilitated by coordination of air conditioning system and cooling fans Automation Science and Engineering (CASE), 2017 13th IEEE Conference on 918-923 2017 IEEE
340. Jin, Ming; Liu, Shichao; Tian, Yulun; Lu, Mingjian; Schiavon, Stefano; Spanos, Costas; Indoor environmental quality monitoring by autonomous mobile sensing Proceedings of the 4th ACM International Conference on Systems for Energy-Efficient Built Environments 20 2017 ACM

341. Leahy, Kevin; Hu, R Lily; Konstantakopoulos, Ioannis C; Spanos, Costas J; Agogino, Alice M; O'Sullivan, Dominic TJ; Diagnosing and predicting wind turbine faults from SCADA data using support vector machines 2018 Prognostics and Health Management Society
342. Jain, Palak; Poon, Jason; Jian, Li; Spanos, Costas; Sanders, Seth R; Xu, Jian-Xin; Panda, Sanjib Kumar; An improved robust adaptive parameter identifier for DC-DC converters using H-infinity design Applied Power Electronics Conference and Exposition (APEC), 2018 IEEE 2922-2926 2018 IEEE
343. Weekly, Kevin; Jin, Ming; Zou, Han; Hsu, Christopher; Soyza, Chris; Bayen, Alexandre; Spanos, Costas; Building-in-Briefcase: A Rapidly-Deployable Environmental Sensor Suite for the Smart Building Sensors (Basel, Switzerland) 18 5 2018 Multidisciplinary Digital Publishing Institute (MDPI)
344. Jia, Ruoxi; Konstantakopoulos, Ioannis C; Li, Bo; Spanos, Costas; Poisoning Attacks on Data-Driven Utility Learning in Games 2018 Annual American Control Conference (ACC) 5774-5780 2018 IEEE
345. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Jiang, Hao; Xie, Lihua; Spanos, Costas J; Deepsense: Device-free human activity recognition via autoencoder long-term recurrent convolutional network 2018 IEEE International Conference on Communications (ICC) 1-6 2018 IEEE
346. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Jiang, Hao; Xie, Lihua; Spanos, Costas J; WiFi-enabled Device-free Gesture Recognition for Smart Home Automation 2018 IEEE 14th International Conference on Control and Automation (ICCA) 476-481 2018 IEEE
347. Pang, Yipeng; Hu, Guoqiang; Spanos, Costas J; Distributed Model Predictive Control of a HVAC System via a Projected Subgradient Method 2018 IEEE 14th International Conference on Control and Automation (ICCA) 878-883 2018 IEEE
348. Liu, Shichao; Jin, Ming; Das, H; Spanos, C; Schiavon, Stefano; Personal thermal comfort models based on physiological parameters measured by wearable sensors Proceedings of the Windsor Conference 431-441 2018
349. Zou, Han; Yang, Jianfei; Zhou, Yuxun; Xie, Lihua; Spanos, Costas J; Robust WiFi-Enabled Device-Free Gesture Recognition via Unsupervised Adversarial Domain Adaptation 2018 27th International Conference on Computer Communication and Networks (ICCCN) 1-8 2018 IEEE
350. Krishnan, KR; Chinh, Hoang Duc; Gupta, Manish; Panda, SK; Spanos, Costas J; Context-Aware Plug-Load Identification Towards Enhanced Energy Efficiency in the Built Environment 2018 IEEE International Conference on Environment and Electrical Engineering and 2018 IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe) 1-6 2018 IEEE
351. Zhou, Yuxun; Zou, Han; Arghandeh, Reza; Gu, Weixi; Spanos, Costas J; Non-parametric outliers detection in multiple time series a case study: Power grid data analysis Thirty-Second AAAI Conference on Artificial Intelligence 2018
352. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Gu, Weixi; Xie, Lihua; Spanos, Costas J; Wifi-based human identification via convex tensor shapelet learning Thirty-Second AAAI Conference on Artificial Intelligence 2018
353. Jin, Ming; Jia, Ruoxi; Das, Hari Prasanna; Feng, Wei; Spanos, Costas; Biscuit: Building intelligent system customer investment tools Proc. 10th International Conference on Applied Energy (ICAE) 2018
354. H Zou, J Yang, H Prasanna Das, H Liu, Y Zhou, CJ Spanos, WiFi and Vision Multimodal Learning for Accurate and Robust Device-Free Human Activity Recognition, Proceedings of

The IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops, 2019, pp. 0-0

355. Zou, Han; Yang, Jianfei; Zhou, Yuxun and Spanos, Costas J, Joint Adversarial Domain Adaptation for Resilient WiFi-Enabled Device-Free Gesture Recognition, 2018 17th IEEE International Conference on Machine Learning and Applications (ICMLA), 202—207, 2018, IEEE
356. Zou, Han; Zhou, Yuxun; Yang, Jianfei; Liu, Huihan; Das, Hari Prasanna and Spanos, Costas J, Consensus adversarial domain adaptation, Proceedings of the AAAI Conference on Artificial Intelligence 33, 5997—6004, 2019
357. Zou, Han; Yang, Jianfei; Prasanna Das, Hari; Liu, Huihan; Zhou, Yuxun and Spanos, Costas J, WiFi and Vision Multimodal Learning for Accurate and Robust Device-Free Human Activity Recognition, Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, 2019
358. Das, Hari Prasanna; Konstantakopoulos, Ioannis C; Manasawala, Aummul Baneen; Veeravalli, Tanya; Liu, Huihan; Spanos, Costas J; ,A novel graphical lasso based approach towards segmentation analysis in energy game-theoretic frameworks, 2019 18th IEEE International Conference On Machine Learning And Applications (ICMLA),1702-1709, 2019,IEEE
359. Spangher, Lucas; Tawade, Akaash; Devonport, Alex; Spanos, Costas; ,Engineering vs. Ambient type visualizations: Quantifying effects of different data visualizations on energy consumption, Proceedings of the 1st ACM International Workshop on Urban Building Energy Sensing, Controls, Big Data Analysis, and Visualization,14-22, 2019
360. Das, Hari Prasanna and Konstantakopoulos, Ioannis C and Manasawala, Aummul Baneen and Veeravalli, Tanya and Liu, Huihan and Spanos, Costas J, A novel graphical lasso based approach towards segmentation analysis in energy game-theoretic frameworks, 2019 18th IEEE International Conference On Machine Learning And Applications (ICMLA), 1702--1709, 2019, IEEE
361. Periyakoil, Divya and Das, Hari Prasanna and Spanos, Costas J, Understanding Distributions of Environmental Parameters for Thermal Comfort Study in Singapore, Proceedings of the Eleventh ACM International Conference on Future Energy Systems, 461--465, 2020
362. Spangher, Lucas and Gokul, Akash and Khattar, Manan and Palakapilly, Joseph and Tawade, Akaash and Bouyamourn, Adam and Devonport, Alex and Spanos, Costas,
363. Prospective experiment for reinforcement learning on demand response in a social game framework, Proceedings of the Eleventh ACM International Conference on Future Energy Systems, 438--444, 2020
364. Spangher, Lucas and Gokul, Akash and Khattar, Manan and Palakapilly, Joseph and Agwan, Utkarsha and Tawade, Akaash and Spanos, Costas, Augmenting Reinforcement Learning with a Planning Model for Optimizing Energy Demand Response, Proceedings of the 1st International Workshop on Reinforcement Learning for Energy Management in Buildings \& Cities, 39--42, 2020
365. Chandra, Rohit and Thong, Hoan and Goh, Edwin and Panda, Sanjib Kumar and Spanos, Costas J and others, Demonstration of Transactive Control of Commercial Buildings as Energy Nodes, IECON 2020 The 46th Annual Conference of the IEEE Industrial Electronics Society, 1968--1973, 2020, IEEE
366. Chandra, Rohit and Yadav, Gorla Naga Brahmendra and Subramaniam, Aravinth and Malik, Hasmat and Panda, Sanjib Kumar and Poolla, Kameshwar and Spanos, Costas J, A Survey of

Failure Mechanisms and Statistics for Critical Electrical Equipment in Buildings, IECON 2020 The 46th Annual Conference of the IEEE Industrial Electronics Society, 1955--1961, 2020, IEEE

367. Yang, Jianfei and Zou, Han and Xie, Lihua and Spanos, Costas J, Deep Learning and Unsupervised Domain Adaptation for WiFi-based Sensing, Generalization With Deep Learning: For Improvement On Sensing Capability, 79--100, 2021

Workshops, Tutorials, Invited Talks and Reports

368. Costas J. Spanos, "Process Characterization and Diagnosis", Third Annual SRC/DARPA, CIM-IC Workshop, Stanford University, August 1988.
369. Costas J. Spanos, "Equipment Diagnostics for Semiconductor Manufacturing", SPC Workshop, IEEE Symposium on VLSI Technology, Kyoto, Japan, May 1989.
370. N. H. Chang and Costas J. Spanos, "A CAM Framework and its Application for Monitoring and Diagnosis in VLSI Manufacturing", Fourth Annual SRC/DARPA CIM-IC Workshop, University of Michigan, August 1989.
371. K. K. Lin and Costas J. Spanos, "Statistical Equipment Modeling and Recipe Generation for VLSI Manufacturing", Fourth Annual SRC/DARPA CIM-IC Workshop, University of Michigan, August 1989.
372. Costas J. Spanos (editor), "Special Issues in Semiconductor Manufacturing - I", EECS, University of California at Berkeley, Memorandum No. UCB/ERL M90/8, January 1990.
373. Costas J. Spanos, "Statistical Process Control in Semiconductor Manufacturing", Short Course, University of California Extension School, San Francisco, CA, May 24-25 1990.
374. Costas J. Spanos, "Statistical Process Control in Semiconductor Manufacturing", Invited Tutorial, IMEC Summer Course in Manufacturing Science, Leuven Belgium, June 1990.
375. Costas J. Spanos, "Creating and Using Equipment Models in Semiconductor Manufacturing", Invited Tutorial, IMEC Summer Course in Manufacturing Science, Leuven Belgium, June 1990.
376. Costas J. Spanos, "Using Regression Equations for Model-Based Diagnosis in the Berkeley Computer-Aided Manufacturing System", Workshop on Intelligent Diagnostic and Control Systems for Manufacturing, AAAI, Boston, MA, July 1990.
377. G. S. May and Costas J. Spanos, "Modeling and Diagnosis of a Plasma Etcher", Fifth Annual SRC/DARPA CIM-IC Workshop, Berkeley, CA, August 1990.
378. Z. M. Ling and Costas J. Spanos, "In-Line Supervisory Control in a Photolithography Workcell", Fifth Annual SRC/DARPA CIM-IC Workshop, Berkeley, CA, August 1990.
379. H. F. Guo and Costas J. Spanos, "Multivariate SPC of a Plasma Etcher", Fifth Annual SRC/ DARPA CIM-IC Workshop, Berkeley, CA, August 1990.
380. Costas J. Spanos, "Statistical Process Control in Semiconductor Manufacturing", Microelectronic Engineering 10 (1991) pp. 271-276, Elsevier Science Publishers.
381. Costas J. Spanos, "Creating and Using Equipment Models in Semiconductor Manufacturing", Microelectronic Engineering 10 (1991) pp. 199-205, Elsevier Science Publishers.
382. Costas J. Spanos (editor), "Special Issues in Semiconductor Manufacturing - II", EECS, University of California at Berkeley, Memorandum No. UCB/ERL M91/8, January 1991.
383. Costas J. Spanos, "Issues in Real-Time Statistical Process Control", Invited Paper, presented at the 1991 SRC Workshop on real Time Controllers, Vancouver, February 19, 1991.

384. Costas J. Spanos, “What is Statistical Process Control?”, 1991 International Semiconductor Manufacturing Sciences Symposium, Workshop on SPC, San Mateo, CA, May 21, 1991.
385. Costas J. Spanos, “Tool Control - Objectives for the year 2000 and beyond”, White paper commissioned by SRC and Sematech, June 1991.
386. Costas J. Spanos, “Equipment and Process Control Issues”, Sixth Annual SRC/DARPA CIM-IC Workshop, North Carolina State University, NC, August 1991
387. Costas J. Spanos, “The Berkeley Computer-Aided Manufacturing System”, Sixth Annual SRC/ DARPA CIM-IC Workshop, North Carolina State University, NC, August 1991
388. S. Leang and Costas J. Spanos, “Statistically-Based feedback Control”, Sixth Annual SRC/ DARPA CIM-IC Workshop, North Carolina State University, NC, August 1991.
389. S. Lee and Costas J. Spanos, “Rapid Development of Physically-Based Equipment Models”, Sixth Annual SRC/DARPA CIM-IC Workshop, North Carolina State University, NC, August 1991.
390. E. Boskin and Costas J. Spanos, “Binning of Commodity ICs”, Sixth Annual SRC/DARPA CIM- IC Workshop, North Carolina State University, NC, August 1991.
391. K. K. Lin and Costas J. Spanos, “Development and Applications of Equipment-Specific Process Models for Semiconductor Manufacturing”, book chapter in Intelligent Modeling, Diagnosis and Control of Manufacturing Processes, by World Scientific Publishing 1992.
392. Costas J. Spanos (editor), “IC Design for Manufacturability”, EECS, University of California at Berkeley, Memorandum No. UCB/ERL M92/17, February 1992.
393. Costas J. Spanos, “The Berkeley Computer-Aided Manufacturing System”, Invited Talk, Sematech Process and Equipment Control Workshop, March 18, 1992.
394. Costas J. Spanos, “The Berkeley Computer-Aided Manufacturing System”, Invited Talk, SRC Video Course, June 9, 1992.
395. Costas J. Spanos, “A Multi-Variate, Multi-Step Equipment Controller”, Invited talk given at the DEC Technical Seminar Series in Hudson, MA, June 10, 1992.
396. Costas J. Spanos, “The Berkeley Real-Time Statistical Process Control Method”, Invited talk given at IBM in Fishkill NY on June 11, 1992.
397. Costas J. Spanos, “Statistical Process Control in Semiconductor Manufacturing”, 1992 International Semiconductor Manufacturing Sciences Symposium, Workshop on SPC, San Francisco, CA, June 17, 1992.
398. H-C Liu and Costas J. Spanos, “Automatic Time-Series Model Generation for Semiconductor Manufacturing”, Seventh Annual SRC/DARPA CIM-IC Workshop, Stanford University, August 1992.
399. R. Chen and Costas J. Spanos, “Fuzzy Modeling of Semiconductor Processing Equipment”, Seventh Annual SRC/DARPA CIM-IC Workshop, Stanford University, August 1992.
400. Costas J. Spanos, S. Leang and J. Thomson, “A Supervisory Controller for Semiconductor Manufacturing”, Seventh Annual SRC/DARPA CIM-IC Workshop, Stanford University, August 1992.
401. Costas J. Spanos and L. Rowe, “The Berkeley CIM/CAM Research Program”, Invited talk at the Seventh Annual SRC/DARPA CIM-IC Workshop, Stanford University, August 1992.
402. Costas J. Spanos (editor), “Special Issues in Semiconductor Manufacturing - III”, EECS, University of California at Berkeley, Memorandum No. UCB/ERL M92/84, August 1992.
403. Costas J. Spanos, S. Leang and S. Lee, “A Control and Diagnosis Scheme for Semiconductor Manufacturing”, Invited Paper to the American Control Conference, San Francisco, CA, June 1993.

404. Costas J. Spanos, "Research Directions in Semiconductor Manufacturing", Keynote Speech, Semiconductor Manufacturing Technology Workshop, Hsinchu, Taiwan, March 1993.
405. Costas J. Spanos, "Equipment Diagnosis", Semiconductor Manufacturing Technology Workshop, Hsinchu, Taiwan, March 1993.
406. Neureuther, Costas J. Spanos, M. Hatzilambrou and C. Yu, "Concurrent Circuit Design/ Process Engineering in a Flexible Manufacturing Environment", White Paper, EECS, University of California at Berkeley, Memorandum No. UCB/ERL M93/91, December 1993.
407. Costas J. Spanos (editor), "Special Issues in Semiconductor Manufacturing - IV", EECS, University of California at Berkeley, Memorandum No. UCB/ERL M94/2, February 1994.
408. Costas J. Spanos, S. Cunningham and L. Smith, "The Statistics of In-Situ particle Monitoring", Invited paper, presented at the meeting of the Electrochemical Society, May 1994.
409. J. Spanos, "Advance Process Identification Techniques", book chapter in Statistical Approach to VLSI Design, series in Advances in CAD for VLSI by North Holland Publishing Co, 1994.
410. Costas J. Spanos, "The Berkeley Computer-Aided Manufacturing System", invited talk presented at the VI AEC/APC Sematech Workshop, September 1994.
411. Costas J. Spanos, "The Intelligent Factory - Applying Process Control in Semiconductor Manufacturing", invited talk, presented at the Korean Automatic Control Conference, October 1994, also at DEC Technical Seminar Series and Arizona State University, November 1994.
412. Costas J. Spanos, Sherry Lee, Roawen Chen, Tony Miranda, Sundeep Rangan and Herb Huang, "From Open Loop to Run-to-run and Real-time Control for Plasma Processes", invited talk, presented at the 3rd International Workshop on Advanced Plasma Tools, May 3, 1995.
413. Costas J. Spanos and Shang-Yi Ma, "A Multistep Supervisory Controller for Photolithographic Operations", invited talk at the 187th ECS Meeting, 1st Symposium on Process Control, Diagnostics and Modeling in Semiconductor Manufacturing, Reno, May 21-26, 1995.
414. R. L. Chen and Costas J. Spanos, "Fuzzy Inference System For Semiconductor Manufacturing Processes", invited paper in the Proceeding of Applications of Fuzzy Logic Technology II, SPIE 1995 Symposium on OE/Aerospace Sensing and Dual Use Photonics, 17-21 April 1995, Orlando, Florida.
415. Costas J. Spanos (editor), "Special Issues in Semiconductor Manufacturing - V", EECS, University of California at Berkeley, Memorandum No. UCB/ERL M95/63, August 1995.
416. Costas J. Spanos (editor), "Special Issues in Semiconductor Manufacturing - VI", EECS, University of California at Berkeley, Memorandum No. UCB/ERL M95/64, August 1995.
417. Costas J. Spanos, "The Intelligent IC Factory", 32 min video tape made by the Semiconductor Research Corporation, September 1995.
418. Costas J. Spanos, "Real-time plasma modeling and Control", invited talk presented at the VII AEC/APC Sematech Workshop, October 1995.
419. Costas J. Spanos, "Fault Detection and Process Control under Development in the University Community - What is Possible in the Future?", invited talk at the 1996 Manufacturing Science and Technology Group technical sessions at AVS, October 1996.
420. Costas J. Spanos, "Advanced Process Control - Does it belong in IC Production?", invited tutorial presented at the 6th AEC/APC Workshop, given by Sematech, October 1996.
421. Costas J. Spanos, "The Next Generation Photolithography Control", Professional Lithography Workshop, Belgium, October 1997.
422. Costas J. Spanos, "Advanced Lithography Control", short course given at SPIE's 23rd Annual International Symposium on Microlithography, February 1998.

423. Costas J. Spanos, Panel Discussion Integrated Metrology: Effective Hardware and Control Strategies, SPIE 2003.
424. Costas J. Spanos, "APC Landscape in the Semiconductor Industry", Keynote, Intel Semiconductor Manufacturing Conference, Phoenix, AZ, March 2003
425. Costas J. Spanos, "Some Thoughts on Integrated Metrology & Control", Panel Discussion, Intel APC Summit, Albuquerque NM, March 2004
426. Costas J. Spanos, "Coping with Variability in Semiconductor Manufacturing", Invited Paper, Modeling and Control for Microelectronics Manufacturing (Invited Session), American Institute of Chemical Engineers, 2004 Annual Meeting, Austin, Texas, November 2004
427. Costas J. Spanos, "Advanced Process Control Landscape in the Semiconductor Industry", Invited Panelist to Intel Corporation's AEC/APC conference on March 2005,
428. Costas J. Spanos, "Advanced Process Control Landscape in the Semiconductor Industry", KLA Webcast, March 2005
429. Paul Friedberg, Willy Cheung, and Costas J. Spanos, "Spatial Variability of Critical Dimensions," VLSI/ULSI Multilevel Interconnection Conference XXII, pp. 539-546, Sept 2005.
430. Costas J. Spanos and Tom Sonderman, "Advanced Process Control in Semiconductor Manufacturing", WebCast by the American Institute of Chemical Engineers, 10/28/2005.
431. Costas J. Spanos, "Metrology in the DFM Era", Invited Keynote to Timbre/TEL user's forum, February 26, 2007, San Jose, CA.
432. Mei Sun and Costas J. Spanos, "Wafer-based Metrology Systems", Invited Keynote to KLA-Tencor Inventions Luncheon, March 8, 2007, Santa Clara, CA.
433. Costas J. Spanos, "Opportunities in Semiconductor Manufacturing", CITRIS Asia Taipei & HsinChu, Taiwan, March 27-28, 2007.
434. Jing Xue and Costas J. Spanos, "An Integrated Aerial Image Sensor for Lithography Diagnostics", International Workshop on Electron Devices and Semiconductor Technology (IEDST 2007) June 3-4, 2007, Tsinghua University, Beijing, China
435. Invited Panelist on Design for Manufacturability discussion at the 2008 SPIE conference (Society of Photo-Optical Instrumentation Engineers), February 2008.
436. Invited Presenter at the CITRIS-Copenhagen Research Conference on Climate and Energy, June 19-20, 2008.
437. Costas J. Spanos, "Needed Innovations at the Design-Manufacturing Interface", Invited Talk, CITRIS Exchange, November 14th, 2007.
438. Costas J. Spanos, "Design for Manufacturability of State of the Art Integrated Circuits", Invited Talk, July 11th, 2008, University of Science Technology of China, Hefei, China.
439. Costas J. Spanos, "Modelling IC Variability for Process-Design Co-Optimization", Invited Talk, Semiconductor Research Corporation, e-Workshop, September 24th, 2008.
440. Sam Sivakumar, Tim Brunner and Costas J. Spanos, "Concerning the obvious superiority of MfD over DfM", Invited Panel, SPIE, San Jose, CA, February 25th 2009.
441. Costas J. Spanos, "Can IT Innovation Solve the Energy Challenge? Buildings, Distribution, Computing", Invited Talk at Google, May 5 2009
442. Costas J. Spanos, "Building Energy Systems", Invited talk at CITRIS-Siemens conference, Munich, Germany, May 28, 2009.
443. Costas J. Spanos, "Energy Efficiency in Buildings", Short course at the Haas School of Business, UC Berkeley, CA, August 18th, 2009.
444. Costas J. Spanos, "IC Variability – An Overview", IMPACT Seminar, November 18th, 2009.

445. Costas J. Spanos, “Connected Buildings: Energy Efficiency, Demand/ Response, and ICT”, invited talk, Changua Leadership Institute in collaboration with CISCO, Berkeley, CA, May 12, 2010.
446. Costas J. Spanos, “Statistical Description of Process Variability”, First International Variability Characterization Workshop, Hsinchu, Taiwan, April 30th, 2010.
447. Costas J. Spanos, “Reducing Data Centers’ Environmental Footprint Without Compromising Performance and Competitiveness”, Invited Talk, International Green energy Forum, Shanghai, China, June 18-20, 2010.
448. Costas J. Spanos, “A Roadmap towards Highly Efficient Buildings”, 2nd Tsinghua - UCB Forum for Green Electronics and Buildings, Beijing, June 22nd, 2010.
449. Costas J. Spanos, “Design for Manufacturability of State of the Art Integrated Circuits”, Invited Seminar, Corallia, Athens, Greece, June 30th, 2010.
450. Costas J. Spanos, “The Self-Optimizing Building”, Invited talk at Hong Kong University, December 17th, 2010.
451. Costas J. Spanos, “Integrated Circuit Variability”, Invited Talk at Hong Kong University of Science and Technology, December 20th, 2010.
452. Costas J. Spanos, “Buildings and Energy”, Invited Dinner Talk, LoCal Retreat., Tahoe, CA, January 13th, 2011.
453. Costas J. Spanos, “Some thoughts on Electricity and its Engineering”, Invited Panel Discussion at the Electrical and Computer Engineering Department Heads Association Meeting, Phoenix, AZ, March 14th, 2011.
454. Costas J. Spanos, “The Self-Optimizing Building”, Tsinghua University, Beijing, China, March 23rd 2011.
455. Costas J. Spanos, “Technology Transfer Stories”. Invited Talk at the National Academies Board on Science, Technology, and Economic Policy, Palo Alto, CA, October 27th, 2011.
456. Costas J. Spanos, “Capturing, Modeling and Leveraging Process Variability in IC Design, Invited Keynote at the Design Technologies Workshop, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, January 19th, 2012.
457. Costas J. Spanos, “Leveraging Variability in Design, Manufacturing and Energy Sustainability”, invited Talk, Singapore University of Technology and Design, Singapore, July 3rd, 2012.
458. Costas J. Spanos, “The Agile Building”, Invited Keynote, 2nd International Conference on Building Energy and Environment, Boulder, Colorado, August 2nd, 2012.
459. Costas J. Spanos, “Capturing and Leveraging Process Variability”, Invited Talk, Nanometrics, October 2nd, 2012.
460. Costas J. Spanos, “The Realities of Virtual Metrology”, Invited Talk, International Symposium on Semiconductor Manufacturing, Tokyo, Japan, October 17th, 2012.
461. Costas J. Spanos, “Capturing, Modeling and Leveraging Process Variability in IC Design”, Invited Talk, Carnegie Mellon University, March 28th, 2013.
462. Costas J. Spanos, “Building Efficiency and Sustainability in the Tropics”, Invited Talk, International Green Building Conference, Singapore, September 12th, 2013.
463. Costas J. Spanos, “Building Efficiency and Sustainability in the Tropics”, Invited Talk, ETH Zurich, March 6th, 2014.
464. Pushkar P. Apte, Costas J. Spanos, Masayoshi Tomizuka, Edwin Goh and SinBerBEST Team, “Integrated Cyber-Physical Test bed to Optimize Energy Efficiency & Human Comfort in Buildings”, Invited Workshop, CASE 2015.

465. Costas J. Spanos, "Building Energy Efficiency and Sustainability in the Tropics", Invited Talk, Tsinghua-Berkeley Schengen institute, Invited Talk, November 3rd, 2015
466. Costas J. Spanos, "Exponentials, Sigmoids, and Inventing the New Wheel", QTECH 2016 (Qualcomm Invited keynote), June 29, 2016
467. Costas J. Spanos, "Building the Brave New World", BECA Asia leadership Conference 2016. Invited keynote, Singapore, August 2nd, 2016
468. Costas J. Spanos, Yuxun Zhou, Ming Jin, Ruoxi Jia, Zhanbo Xu, Han Zou, Ioannis Konstantakopoulos, Dan Li, Weixi Gu, Hu Guojiang, "Smart Buildings as Cyber-Physical Systems: Statistical Learning, Control and Automatic Design", SmartGridComm, Sydney, November 6, 2016
469. Costas J. Spanos, "How to trim 10 Terawatts of Electricity - Smart buildings in the Tropics", Invited talk, Building Energy Efficiency Workshop, CDC, Las Vegas, December 11, 2016
470. Costas J. Spanos, "The Next IT Revolution", Executive Education Lecture for ENEL, UC Berkeley, May 10, 2017.
471. Costas J. Spanos, "Exponentials, Sigmoids, and Imagining and New IT Revolution", Nanyang Technological university, Singapore, Invited Lecture, May 26, 2017.
472. Costas J. Spanos, "Innovation for Industry, CITRIS and the Banatao Institute", Inclusive Innovation Conference 2017, Invited keynote, Manilla, Philippines, May 30, 2017
473. Costas J. Spanos, "Designing Curriculum for A.I.", Inclusive Innovation Conference 2017, Invited keynote, Manilla, Philippines, May 30, 2017
474. Costas J. Spanos, "Academe – Industry Linkages: CITRIS & the Banatao Institute",
475. Costas J. Spanos, "Exponentials, Sigmoids, and Inventing the New Wheel", Samsung Speaker Series, June 27, 2017
476. Wang, Jingkang; Jia, Ruoxi; Friedland, Gerald; Li, Bo; Spanos, Costas; One Bit Matters: Understanding Adversarial Examples as the Abuse of Redundancy arXiv preprint arXiv:1810.09650 2018
477. Das, Hari Prasanna; Konstantakopoulos, Ioannis C; Manasawala, Aummul Baneen; Veeravalli, Tanya; Liu, Huihan; Spanos, Costas J; "Segmentation Analysis in Human Centric Cyber-Physical Systems using Graphical Lasso", arXiv preprint arXiv:1810.10533 2018
478. Konstantakopoulos, Ioannis C; Barkan, Andrew R; He, Shiying; Veeravalli, Tanya; Liu, Huihan; Spanos, Costas; A deep learning and gamification approach to energy conservation at Nanyang Technological University arXiv preprint arXiv:1809.05142 2018
479. Costas J. Spanos "Exponentials, Sigmoids, & Inventing the New Wheel (CITRIS and our work in Singapore)", Invited Lecture, Hong Long University of Science and Technology, January 9, 2018
480. Costas J. Spanos "Exponentials, Sigmoids, & Inventing the New Wheel (CITRIS and our work in Singapore)", Invited Lecture, Tsinghua University, January 12, 2018
481. Costas J. Spanos "Future Impact of Transformative Technologies", Invited Lecture, SEMI CTO Forum, June 13, 2018
482. Han Zhou and Costas J. Spanos "Mining Information from Passive RF Sensing of IoT Networks", NSF IoT Workshop, San Diego, November 4, 2018
483. Costas J. Spanos "Designing a Living Laboratory for Building Energy Efficiency in the Tropics", Invited talk, Building Energy Efficiency Workshop, CDC, Miami, December 16, 2018
484. Das, Hari Prasanna and Konstantakopoulos, Ioannis C and Manasawala, Aummul Baneen and Veeravalli, Tanya and Liu, Huihan and Spanos, Costas J, Segmentation Analysis in Human

Centric Cyber-Physical Systems using Graphical Lasso, arXiv preprint arXiv:1810.10533, 2019
485. Yang, Yu and Hu, Guoqiang and Spanos, Costas J, HVAC Energy Cost Optimization for a Multi-zone Building via a Decentralized Approach, arXiv preprint arXiv:1905.10934, 2019
486. Das, Hari Prasanna and Abbeel, Pieter and Spanos, Costas J, Dimensionality Reduction Flows, arXiv preprint arXiv:1908.01686, 2019
487. Jia, Ruoxi and Dao, David and Wang, Boxin and Hubis, Frances Ann and Gurel, Nezihe Merve and Li, Bo and Zhang, Ce and Spanos, Costas J and Song, Dawn, Efficient Task-Specific Data Valuation for Nearest Neighbor Algorithms, arXiv preprint arXiv:1908.08619, 2019
488. Costas J. Spanos "Harnessing the Next Revolution", Invited Lecture, Lam Research, January 14, 2019
489. Costas J. Spanos "Smart Energy", International Workshop on Applied Machine Learning for Intelligent Energy Systems, June 25, 2019
490. Costas J. Spanos "Harnessing the Smart Energy Revolution", invited Seminar, Nanyang Technological University, Singapore, August 13, 2019
491. Das, Hari Prasanna; Abbeel, Pieter; Spanos, Costas J; ,Dimensionality reduction flows, arXiv preprint arXiv:1908.01686, 2019
492. Jia, Ruoxi; Dao, David; Wang, Boxin; Hubis, Frances Ann; Gurel, Nezihe Merve; Li, Bo; Zhang, Ce; Spanos, Costas J; Song, Dawn; ,Efficient task-specific data valuation for nearest neighbor algorithms, arXiv preprint arXiv:1908.08619, 2019
493. Yang, Yu; Hu, Guoqiang; Spanos, Costas J; ,A Proximal Linearization-based Decentralized Method for Nonconvex Problems with Nonlinear Constraints, arXiv preprint arXiv:2001.00767, 2020
494. Konstantakopoulos, Ioannis C; Hamilton, Kristy A; Veeravalli, Tanya; Spanos, Costas; Dong, Roy; smartSDH: A Mechanism Design Approach to Building Control, arXiv preprint arXiv:2001.02807, 2020
495. Prasanna Das, Hari; Konstantakopoulos, Ioannis C; Baneen Manasawala, Aummul; Veeravalli, Tanya; Liu, Huihan; Spanos, Costas J; ,A Novel Graphical Lasso based approach towards Segmentation Analysis in Energy Game-Theoretic Frameworks, arXiv, arXiv: 1910.02217, 2019
496. Konstantakopoulos, Ioannis C; Das, Hari Prasanna; Barkan, Andrew R; He, Shiying; Veeravalli, Tanya; Liu, Huihan; Manasawala, Aummul Baneen; Lin, Yu-Wen; Spanos, Costas J; ,Design, benchmarking and explainability analysis of a game-theoretic framework towards energy efficiency in smart infrastructure, arXiv preprint arXiv:1910.07899, 2019,
497. Yang, Yu; Hu, Guoqiang; Spanos, Costas J; ,Stochastic Optimal Control of HVAC system for Energy-efficient Buildings, arXiv preprint arXiv:1911.00840, 2019,
498. Yang, Yu and Hu, Guoqiang and Spanos, Costas J, A Proximal Linearization-based Decentralized Method for Nonconvex Problems with Nonlinear Constraints, arXiv preprint arXiv:2001.00767, 2020
499. Konstantakopoulos, Ioannis C and Hamilton, Kristy A and Murthy, Yashaswini and Veeravalli, Tanya and Spanos, Costas and Dong, Roy, smartSDH: A Mechanism Design Approach to Building Control, arXiv preprint arXiv:2001.02807, 2020
500. Yang, Yu and Hu, Guoqiang and Spanos, Costas J, Optimal Sharing and Fair Cost Allocation of Community Energy Storage, arXiv preprint arXiv:2010.15455, 2020

501. Yang, Yu and Agwan, Utkarsha and Hu, Guoqiang and Spanos, Costas J, Selling Renewable Utilization Service to Consumers via Cloud Energy Storage, arXiv preprint arXiv:2012.14650, 2020

Issued US Patents

1. 9,029,728, "Methods of and apparatuses for measuring electrical parameters of a plasma process"
2. 8,698,037, "Methods of and apparatuses for maintenance, diagnosis, and optimization of processes"
3. 7,960,670, "Methods of and apparatuses for measuring electrical parameters of a plasma process"
4. 7,580,767, "Methods of and apparatuses for maintenance, diagnosis, and optimization of processes"
5. 7,531,984, "Sensor apparatus power transfer, communication and maintenance methods and apparatus"
6. 7,403,834, "Methods of and apparatuses for controlling process profiles"
7. 7,299,148, "Methods and apparatus for low distortion parameter measurements"
8. 7,282,889, "Maintenance unit for a sensor apparatus"
9. 7,016,754, "Methods of and apparatus for controlling process profiles"
10. 6,741,945, "Sensor geometry correction methods and apparatus"
11. 6,738,722, "Data collection and correction methods and apparatus"
12. 6,691,068, "Methods and apparatus for obtaining data for process operation, optimization, monitoring, and control"